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ABSTRACT

The materials in this document are an extension of a catalog of occupational duties, tasks, and performance objectives relevant to maintaining automotive suspension systems, brakes, and steering mechanisms. This document provides the following for each occupational task within each duty: (1) a standard of performance; (2) the conditions under which the task is to be performed; (3) enabling objectives; (4) at least one resource; (5) one or more teaching activities; (6) criterion-referenced measures of student performance; (7) answers to those measures; (8) practical applications; and (9) a suggested method of evaluating the practical application. The appendices contain a list of tasks associated with the three duties (maintaining suspension, maintaining steering system, and maintaining brake system); definitions of terms; a list of tools, equipment, and work aids; reference to those who are the source of the information contained in the document; a list of 14 items called "state-of-the-art literature"; and a 19-item bibliography. (CML)

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V-TECS GUIDE

FOR

AUTO MECHANICS: SUSPENSION SYSTEMS, BRAKES AND STEERING

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ACKNOWLEDGMENTS

The Auto Mechanics: Suspension Systems, Brakes and Steering V-TECS Guide was developed from the Auto Mechanics: Suspension Systems, Brakes and Steering V-TECS Catalog by a committee of Automotive Mechanics instructors from South Carolina. Special appreciation is extended to the following teachers who devoted their time and talents to this project:

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Upon completion of the writing of Auto Mechanics: Suspension Systems, Brakes and Steering V-TECS Guide, thirteen individuals were selected to field review the materials for validity and reliability. These individuals are to be commended for their efforts in assisting with this project. The field reviewers are:

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INTRODUCTION

A V-TECS Guide is an extension or a continuation of one or more V-TECS Catalogs. The V-TECS Catalog is a composition of duties, tasks, performance objectives, and performance guides which deal with the psychomotor aspect of an occupation. The catalog can be considered the blueprint of an occupation.

The catalog serves as the foundation for the V-TECS Guide. Experience has shown that the art of learning can be taught while teaching subject matter. A V-TECS Guide provides an efficient method for this process. The Guide addresses the three domains of learning: psychomotor, cognitive, and affective. The following is a brief explanation of each.

Psychomotor

Manipulative skills, such as sharpening a pencil and making a bulletin board display, are representative of activities that are psychomotor in nature. These tasks are identified in a catalog and grouped by duties and objectives. Each performance objective has a performance standard which must be met to demonstrate student proficiency in the manipulative aspect of the task.

Cognitive

Cognition is the mental process by which knowledge is acquired. To perform psychomotor tasks, students must think. Effective thinking is necessary for successful performance of job tasks. Students gain cognition through real and

vicarious experiences. This guide enables the instructor to provide decision-making opportunities for students, thus developing their cognitive skills.

Affective

The affective domain deals with attitudes, interests, and values development. Desirable behavior is the learning outcome of the affective domain. This guide presents activities created to promote an understanding of self and others in a working environment. The instructor is encouraged to use the activities to stress how attitudes, values, and goal attainment influence working relationships and productivity.

USE OF V-TECS GUIDE

A V-TECS Guide is designed to provide job-relevant tasks, performance objectives, performance guides, resources, teaching activities, evaluation standards, and criterion-referenced measures. It may be used with any teaching method the instructor chooses. Although a guide contains suggestions for specific classroom activities for each identified task, teachers are encouraged to be creative in adapting the material to meet the particular needs of their students.

MAINTAINING SUSPENSION

DUTY MAINTAINING SUSPENSION

PERFORMANCE OBJECTIVE 1

TASK

Check air pressure and inflate tires.

STANDARD OF PERFORMANCE OF TASK

Pressure in all tires must be in accordance to manufacturer's specifications.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Tire gauge
Work order

ENABLING OBJECTIVES

1. Read and interpret manufacturer's specifications.
2. Identify process of operating tools correctly.

RESOURCE

Mitchell Automechanics, pp. 108-09.

TEACHING ACTIVITIES

1. Discuss radial and bias-belted tires and the problems that may be encountered.
2. Have students locate manufacturer's tire pressure specifications in shop manuals or charts.
3. Show how to check tire pressure and demonstrate inflation procedures.
4. Demonstrate tread depth measurements.
5. With a specific vehicle, have students properly gauge tire pressure and tread depth.

PERFORMANCE OBJECTIVE 1

CRITERION-REFERENCED MEASURE

Questions

1. Tire pressure increases or decreases as its temperature rises?
   a. increases
   b. decreases
   c. unchanging

2. A vehicle has two radial ply tires and two bias-ply tires installed on it. Where must the two radial-ply tires be placed?
   a. on the front of the vehicle
   b. on the left of the vehicle
   c. on the rear of the vehicle

3. Which prevents air from escaping the tire?
   a. valve cap
   b. valve core

Answers

1. a
2. c
3. b

Practical Application

Have students check air pressure and inflate tires.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 1 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 1

CHECKING AIR PRESSURE AND INFLATING TIRES

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time.		
3. Consulted shop manual.		
4. Checked to see if tires were all the same size and type. CAUTION: Do not mix radial tires with bias or bias-belted tires.		
5. Gauged tires.		
6. Filled tires to manufacturer's specifications.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING SUSPENSION

PERFORMANCE OBJECTIVE 2

TASK

Inspect tires and wheels.

STANDARD OF PERFORMANCE OF TASK

All irregular wear and damage must be noted.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Depth gauge
Hoist
Work order

ENABLING OBJECTIVES

1. Interpret linear measurements.
2. Read and interpret work order.

RESOURCE

Mitchell Automechanics, pp. 107-09.

TEACHING ACTIVITIES

1. Identify tire wear patterns.
2. Discuss wheel run-out and checking procedures.
3. Demonstrate vehicle lifting procedures and discuss related safety precautions.
4. Show wheel run-out checking procedure.
5. Distribute work orders and have students identify irregular tire or wheel damages.

PERFORMANCE OBJECTIVE 2

CRITERION-REFERENCED MEASURE

Questions

1. A tire or wheel assembly that has excessive lateral run-out should be
   a. placed on the rear of the vehicle.
   b. balanced.
   c. replaced.

2. When checking a wheel for run-out, a dial _____ should be used.

3. Tire over-inflation is indicated by
   a. excessive wear at the center of the tread surface.
   b. spotty wear on the outer edge of the tread surface.
   c. excessive wear at both shoulders of the tread surface.

Answers

1. c
2. indicator
3. a

Practical Application

Have students inspect tires and wheels.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 2 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 2

INSPECTING TIRES AND WHEELS

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Raised and supported vehicle.		
3. Turned each tire at least one rotation, noting wear and irregularities.		
4. Checked wheel for run-out and damage.		
5. Noted damaged tires or wheels.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING SUSPENSION

PERFORMANCE OBJECTIVE 3

TASK

Inspect suspension system.

STANDARD OF PERFORMANCE OF TASK

All damaged and/or out of specification (worn) suspension system parts must be noted.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Rack
Light
Pry bar
Floor jack
Rags
Work order

ENABLING OBJECTIVES

1. Operate hood jack.
2. Read and interpret vehicle manufacturer's specifications.

RESOURCE

Mitchell Automechanics, pp. 530-42.

TEACHING ACTIVITIES

1. Discuss and explain suspension system components principles, design and operation.
2. Show how to perform specific checking procedures, emphasizing safety precautions.
3. Have students prepare a specification and checking procedure form for a specific vehicle.
4. Demonstrate how to check suspension system components.
5. Have student inspect and identify damaged or worn suspension system components.

PERFORMANCE OBJECTIVE 3

CRITERION-REFERENCED MEASURE

Questions

1. A leaking shock absorber or strut should be
   a. repaired.
   b. replaced.
   c. refilled.

2. A ball joint that has excessive play (movement) must be
   a. overhauled.
   b. adjusted.
   c. replaced.

3. Excessive play (movement) in the steering wheel can be caused by
   a. worn sway bar bushings.
   b. low tire pressure.
   c. incorrect vehicle height.
   d. worn steering linkage.

Answers

1. b
2. c
3. d

Practical Application

Have students inspect suspension system.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 3 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 3

INSPECTING SUSPENSION SYSTEM

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Listed all parts used.		
3. Raised and supported vehicle.		
4. Checked for loose wheel bearing.		
5. Checked steering linkage.		
6. Checked ball joints.		
7. Checked shocks.		
8. Checked control arms and bushings.		
9. Checked strut rods and bushings.		
10. Checked front and rear springs and hangers.		
11. Checked sway bar.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING SUSPENSION

PERFORMANCE OBJECTIVE 4

TASK

Remove and replace front wheel bearings (drum brakes).

STANDARD OF PERFORMANCE OF TASK

Wheel bearing nuts must be torqued to manufacturer's specifications.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Basic hand tool set
Torque wrench
Wheel bearing grease
Work order
Floor jack
Shop manual
Wheel bearings
Jack stands

ENABLING OBJECTIVES

1. Identify and describe special hand tools.
2. Review safety precautions.
3. Read and interpret manufacturer's procedures.

RESOURCE

Mitchell Automechanics, pp. 609-11.

TEACHING ACTIVITIES

1. Discuss different types of wheel bearings used on drum brake vehicles, emphasizing safety precautions.
2. Explain loads and weight distribution as it relates to wheel bearings.
3. Have students prepare a list of the steps for wheel bearing replacement.
4. Demonstrate methods of packing grease in wheel bearings.
5. Demonstrate removal and installation of wheel bearings and methods of bearing pre-load.
6. Have students replace damaged or worn wheel bearings.

PERFORMANCE OBJECTIVE 4

CRITERION-REFERENCED MEASURE

Questions

1. If the inner wheel bearing rollers become worn or pitted the
   a. roller cage bearing must be replaced only.
   b. race only must be replaced.
   c. roller cage bearing and race must be replaced.

2. Excessive wheel bearing and play is usually an indication of
   a. loose or worn bearings.
   b. over torqued spindle nut.
   c. incorrect tire balance.

3. The cotter pin through the spindle nut serves the purpose
   a. to retain hub grease cap in place.
   b. to maintain the end play pre-load adjustment.
   c. to prevent wheel bearing races from rotating.

Answers

1. c
2. a
3. b

Practical Application

Have students remove and replace front wheel bearings on a drum brake equipped vehicle.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 4 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 4

REMOVING AND REPLACING FRONT WHEEL BEARINGS (DRUM BRAKES)

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained repair order.		
2. Recorded starting time. NOTE: Listed all parts used.		
3. Raised and supported vehicle.		
4. Removed dust cover, cotter (safety) pin and nut.		
5. Removed outer wheel bearing.		
6. Removed wheel and drum.		
7. Removed inner seal and bearing.		
8. Removed inner and outer bearing races.		
9. Replaced inner and outer wheel bearing races (cups).		
10. Packed bearing with grease. NOTE: Lube must meet manufacturer's specifications.		
11. Replaced inner and outer bearing races.		
12. Installed inner bearings and inner seal.		
13. Replaced wheel and drum.		
14. Replaced inner wheel bearing.		
15. Replaced nut, safety pin, dust cover, torqued to manufacturer's specifications.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 4

REMOVING AND REPLACING FRONT WHEEL BEARINGS (DRUM BRAKES)

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
16. Adjusted brakes, if applicable.		
17. Lowered vehicle and test drove.		
18. Returned vehicle to service.		

APPROVED: YES _____ NO _____

_____

Evaluator's Signature Date

DUTY MAINTAINING SUSPENSION

PERFORMANCE OBJECTIVE 5

TASK

Remove and replace front wheel bearings (disc brakes).

STANDARD OF PERFORMANCE OF TASK

Wheel bearing nuts must be torqued to manufacturer's specifications.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Bearing race installations kit
Jack stands
Cotter pins
Basic hand tool set
Work order
Floor jack
Shop manual

ENABLING OBJECTIVES

1. Identify and recognize brake system types.
2. Read & interpret manufacturer's specifications.

RESOURCE

Mitchell Automechanics, pp. 609-11.

TEACHING ACTIVITIES

1. Discuss the disc brake features and designs as compared to drum brakes.
2. Have students prepare a list of the required steps for disc brake wheelbearing replacement.
3. Demonstrate disc brake caliper removal and installation.
4. Explain wheel bearing replacement procedures on disc brake rotor.
5. Have students replace wheel bearing on a disc brake equipped vehicle.

PERFORMANCE OBJECTIVE 5

CRITERION-REFERENCED MEASURE

Questions

1. To install a brake rotor bearing race, you would use
   a. the removed race as a tool to install the new race.
   b. the special tools specified by the manufacturer.
   c. a socket or block of steel sized to the race, and a hammer.

2. The bearing race in the rotor must be
   a. a press fit.
   b. slip fit.
   c. heated before installation.

3. The wheel bearing seal must be installed with the
   a. lip of the seal turned toward inner bearing.
   b. lip of the seal turned away from the inner bearing.
   c. neither of the above.

Answers

1. b
2. a
3. a

Practical Application

Have students remove and replace front wheel bearings on disc brake equipped vehicle.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 5 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 5

REMOVING AND REPLACING FRONT WHEEL BEARINGS (DISC BRAKES)

Student's Name _____ **Date** _____

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Listed all parts as used.		
3. Raised and supported vehicle.		
4. Removed wheel.		
5. Removed brake caliper.		
6. Removed dust cover.		
7. Removed cotter (safety) pin and nut, and outer bearing.		
8. Removed brake rotor.		
9. Removed inner bearing and seal from rotor.		
10. Removed inner and outer bearing cups.		
11. Packed bearing with grease that met manufacturer's specifications.		
12. Replaced inner & outer bearing race.		
13. Replaced inner bearing and seal in rotor.		
14. Replaced brake rotor.		
15. Replaced outer bearing, retaining washer and nut, torqued nut to manufacturer's specifications and installed new cotter pin.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 5

REMOVING AND REPLACING FRONT WHEEL BEARINGS (DISC BRAKES)

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
16. Replaced dust cover and nut.		
17. Replaced brake caliper (with pads).		
18. Replaced wheel; torqued wheel lugs.		
19. Lowered vehicle and road tested.		
20. Returned vehicle to service.		

APPROVED: YES _____ NO _____

_____

Evaluator's Signature **Date**

DUTY MAINTAINING SUSPENSION

PERFORMANCE OBJECTIVE 6

TASK

Repack wheel bearings.

STANDARD OF PERFORMANCE OF TASK

Bearings must be solidly packed with grease.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Dust cup remover
Basic hand tool set
Cotter pins
Bearing race installation
Hoist
Grease
Shop manual
Work order

ENABLING OBJECTIVES

1. Identify various wheel bearing types.
2. List safety precautions with the use of solvents and compressed air.

RESOURCE

Mitchell Automechanics, pp. 609-11.

TEACHING ACTIVITIES

1. Explain basic wheel bearing types.
2. Discuss safety precautions about solvents and compressed air.
3. Discuss bearing lubricants.
4. Demonstrate wheel bearing cleaning and packing procedures.
5. Have students repack wheel bearings on a specified vehicle.

PERFORMANCE OBJECTIVE 6

CRITERION-REFERENCED MEASURE

Questions

1. The reason a bearing is never allowed to spin with compressed air is
   a. it may damage the bearing.
   b. it may come apart and injure someone.
   c. neither a or b.
   d. both a and b.

2. Wheel bearing lubricant can
   a. be mixed with any type lubricant.
   b. be any type of lubricant.
   c. be only the lubricant specified by the manufacturer.

3. Wheel bearings can be packed by
   a. hand operations only.
   b. machine operations only.
   c. neither a or b.
   d. both a and b.

Answers

1. d
2. c
3. d

Practical Application

Have students repack wheel bearings.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 6 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 6

REPACKING WHEEL BEARINGS

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Listed all parts used.		
3. Washed bearing with solvent and dried with lint free cloth. CAUTION: Do not spin bearings with air.		
4. Packed grease in bearing. Grease used met manufacturer's specifications.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING SUSPENSION

PERFORMANCE OBJECTIVE 7

TASK

Remove and replace shock absorbers.

STANDARD OF PERFORMANCE OF TASK

All nuts and bolts must be tightened; shock must be firmly in place.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Basic hand tool set
Hoist
Pry bar
Penetrating fluid
Work order
Shop manual

ENABLING OBJECTIVES

1. Locate suspension system components.
2. Identify basic hand tools and shop equipment.

RESOURCE

Mitchell Automechanics, pp. 532-36.

TEACHING ACTIVITIES

1. Discuss types of shock absorbers and mounting applications.
2. Describe shock absorber checking methods.
3. Have students locate removal and installation procedures for a specific vehicle using manufacturer manuals.
4. Demonstrate shock absorber removal and installation procedure.
5. Have students replace shock absorbers on a specific vehicle.

PERFORMANCE OBJECTIVE 7

CRITERION-REFERENCED MEASURE

Questions

1. When replacing shock absorbers, Mechanic "A" says to replace one shock on the front of the vehicle, while Mechanic "B" says to always replace shocks in pairs on the front or rear of the vehicle. Who is right?
   a. Mechanic "A"
   b. Mechanic "B"

2. What does a shock absorber do?
   a. controls the riding height of a vehicle
   b. controls or dampens the action of the spring
   c. allows the hydraulic fluid to return to the master cylinder

3. A worn out or leaking shock absorber will
   a. control or dampen body movement.
   b. decrease the vehicle's stopping (braking) distance.
   c. have no effect on vehicle.
   d. allow vehicle to be unstable.

Answers

1. b
2. b
3. d

Practical Application

Have students remove and replace shock absorbers.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 7 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 7

REMOVING AND REPLACING SHOCK ABSORBERS

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Listed all parts used.		
3. Placed vehicle on drive or rack.		
4. Removed top bolts or nuts. NOTE: Most models require that bolts be removed from engine compartment.		
5. Removed bottom bolts or nuts.		
6. Replaced shock absorber.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING SUSPENSION

PERFORMANCE OBJECTIVE 8

TASK

Remove and replace control arms.

STANDARD OF PERFORMANCE OF TASK

All nuts and bolts must be torqued to manufacturer's specifications.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Jack stands
Torch
Pry bar
Basic hand tool set
Control arms
Floorjack
Work order
Shop manual

ENABLING OBJECTIVES

1. Read and interpret work order.
2. Identify and use basic hand tools.

RESOURCE

Mitchell Automechanics, pp. 533-39.

TEACHING ACTIVITIES

1. Review torque wrench use and operation.
2. Discuss suspension systems and safety precautions related to coil and leaf spring service.
3. Review heating torch operation and safety precautions.
4. Have students list control arm replacement procedure as specified by vehicle manufacturer.
5. Demonstrate proper procedure for removal and replacement of control arms.
6. Have students replace control arms on a specific vehicle.

PERFORMANCE OBJECTIVE 8

CRITERION-REFERENCED MEASURE

Questions

1. On a vehicle with rear wheel drive and real coil spring suspension, what carries driving and braking torque?
   a. drive shaft
   b. coil springs
   c. control arms
   d. neither of the above

2. Vehicles that have independent suspension systems on the front usually have
   a. two control arms of equal length per side.
   b. two control arms of different length per side.
   c. four control arms of four different length per vehicle.

3. Ball joints and pivot bushings are mounted at each end of
   a. a steering knuckle.
   b. a stabilizer (sway) bar.
   c. a control arm.

Answers

1. c
2. b
3. c.

Practical Application

Have students remove and replace control arms.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 8 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 8

REMOVING AND REPLACING CONTROL ARMS

Student's Name _____ **Date** _____

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks wtihin a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Listed all parts used.		
3. Raised vehicle and supported at frame on jack stands. CAUTION: Scotch rear wheels and set brakes.		
4. Placed support jack under control arm.		
5. Removed wheel.		
6. Removed shock.		
7. Compressed spring. CAUTION: Spring can slip from compressor and kill.		
8. Removed ball joint nuts.		
9. Knocked ball joint loose using ball joint remover.		
10. Raised vehicle and removed coil spring.		
11. Replaced control arm.		
12. Replaced coil spring.		
13. Replaced ball joint.		
14. Replaced shock.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 8

REMOVING AND REPLACING CONTROL ARMS

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
15. Replaced wheel, wheel nut must be torqued.		
16. Lowered wheels.		
17. Checked alignment.		
18. Returned to service.		

APPROVED: YES _____ NO _____

_____

Evaluator's Signature **Date**

DUTY MAINTAINING SUSPENSION

PERFORMANCE OBJECTIVE 9

TASK

Remove and replace control arm bushings.

STANDARD OF PERFORMANCE OF TASK

Bushings must fit center pin with correct clearance.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Basic hand tool set
Arbor press
Control arm bushings
Dies
Shop manual
Work order

ENABLING OBJECTIVES

1. Identify basic hand tools.
2. Read and interpret shop manual.

RESOURCE

Mitchell Automechanics, pp. 533-39.

TEACHING ACTIVITIES

1. Discuss control arm bushing types and operation.
2. Have students locate manufacturer's procedure for replacement of control arm bushings.
3. Set up arbor press and discuss operation.
4. Show students how to press control arm bushings in control arms.
5. Have students remove and reinstall control arm bushings.

PERFORMANCE OBJECTIVE 9

CRITERION-REFERENCED MEASURE

Questions

1. Most independent front suspension system vehicles, excluding strut type, have
   a. two rubber-bushed control arms per side of the vehicle.
   b. three rubber-bushed control arms per side of the vehicle.
   c. one rubber-bushed control arm per side of the vehicle.

2. When installing control arm bushings, the force should be applied to
   a. the inner sleeve of the bushing.
   b. the outer sleeve of the bushing.
   c. each side of the control arm assembly.

3. Control arm bushings are
   a. pressed into the control arm.
   b. threaded into the control arm.
   c. both a and b.

Answers

1. a
2. b
3. c

Practical Application

Have students remove and replace control arm bushing.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 9 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 9

REMOVING AND REPLACING CONTROL ARM BUSHINGS

Student's Name _____ **Date** _____

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instuctor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Selected proper die, arbor to bushing inside and out.		
2. Placed control arm in press.		
3. Removed bushing.		
4. Reversed dies and replaced control arm bushings.		

APPROVED: YES _____ NO _____

Evaluator's Signature _____ **Date** _____

DUTY MAINTAINING SUSPENSION

PERFORMANCE OBJECTIVE 10

TASK

Remove and replace ball joints.

STANDARD OF PERFORMANCE OF TASK

All nuts and bolts must be torqued to manufacturer's specifications.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Basic hand tool set
Safety pins
Ball joint separator
Hoist
Jack stands
Shop manual
Work order

ENABLING OBJECTIVES

1. Identify vehicle spring safety precautions.
2. State arbor press operation.

RESOURCE

Mitchell Automechanics, pp. 541-42.

TEACHING ACTIVITIES

1. Discuss ball joint types and applications.
2. Have students locate manufacturer's procedure for replacement of ball joints on a specific vehicle.
3. Show students at least two vehicles with ball joint suspension systems.
4. Show students how to replace ball joints in upper and lower control arms.
5. Have students remove and reinstall ball joints.

PERFORMANCE OBJECTIVE 10

CRITERION-REFERENCED MEASURE

Questions

1. Ball joints serve what purpose?
   a. allows the spindle to turn left or right and move up and down with road changes
   b. controls vehicle riding height and provides smooth ride qualities
   c. provides alignment adjustments

2. Ball joints must be replaced when
   a. wear exceeds .050".
   b. wear exceeds .100".
   c. manufacturer's wear limits are exceeded.

3. Ball joint replacement is
   a. the same for all vehicles.
   b. different for some vehicles.
   c. never necessary.

Answers

1. a
2. c
3. b

Practical Application

Have students remove and replace ball joints.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 10 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 10

REMOVING AND REPLACING BALL JOINTS

Student's Name _____ **Date** _____

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Listed all parts used.		
3. Raised vehicle and supported at frame on jack stands.		
4. Placed support jack under control arm.		
5. Removed wheel.		
6. Removed ball joint nuts. CAUTION: Took caution that spring did not slip out causing injury.		
7. Knocked ball joints loose using proper tool.		
8. Removed ball joints. NOTE: Referred to service manual for installation of ball joints.		
9. Replaced ball joints.		
10. Replaced ball joint nuts.		
11. Lubricated ball joints.		
12. Replaced wheel, wheel lugs must be torqued to manufacturer's specifications.		
13. Lowered vehicle.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 10

REMOVING AND REPLACING BALL JOINTS

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
14. Test drove.		
15. Returned vehicle to service.		
16. Recorded labor and parts.		

APPROVED: YES _____ NO _____

_____

Evaluator's Signature **Date**

DUTY MAINTAINING SUSPENSION

PERFORMANCE OBJECTIVE 11

TASK

Remove and replace torsion bar.

STANDARD OF PERFORMANCE OF TASK

Ride height must be adjusted to manufacturer's specifications; torsion bars must not be interchanged.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Lift
Impact wrench & sockets
Basic hand tool set
Torsion bar
Work order
Shop manual

ENABLING OBJECTIVES

1. Read and interpret shop manual.
2. Read lineal measurements.

RESOURCE

Mitchell Automechanics, pp. 535-36.

TEACHING ACTIVITIES

1. Explain torsion bar suspension as it relates to coil spring suspension.
2. Discuss vehicle ride height and methods of adjustment.
3. Have students prepare a list of the steps required for torsion bar replacement.
4. Review safety precautions for spring and torsion bar service.
5. Demonstrate methods of torsion bar replacement.
6. Have students replace torsion bars and adjust vehicle ride height.

PERFORMANCE OBJECTIVE 11

CRITERION-REFERENCED MEASURE

Questions

1. The torsion bar front suspension vehicle uses
   a. two control arms (upper and lower) per side of the vehicle.
   b. one torsion bar per vehicle.
   c. no shock absorbers, as the shock is controlled by the torsion bar.

2. The torsion bar is attached to the frame and to the
   a. upper control arm.
   b. lower control arm.
   c. steering knuckle.
   d. stabilizer bar.

3. Torsion bars are used
   a. on suspension systems.
   b. in place of springs on hoods, luggage door and door hinges.
   c. to support engine and transmission installations.
   d. both a and b.

Answers

1. a
2. b
3. d

Practical Application

Have students remove and replace torsion bar.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 11 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 11

REMOVING AND REPLACING TORSION BAR

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Listed all parts used.		
3. Placed vehicle on lift.		
4. Loosened torsion bar adjustment bolt. CAUTION: The wheel assembly must be supported when removing torsion bar.		
5. Removed rear retainer ring or snap ring.		
6. Slid torsion bar out from rear.		
7. Inserted torsion bar noting correct rotation.		
8. Replaced rear retaining ring or nut.		
9. Lowered vehicle.		
10. Adjusted ride height.		
11. Test drove.		
12. Recorded labor and parts.		
13. Returned vehicle to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING SUSPENSION

PERFORMANCE OBJECTIVE 12

TASK

Remove and replace coil springs.

STANDARD OF PERFORMANCE OF TASK

Replaced coil springs must be properly seated.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Spring compressor
Safety pins
Basic hand tool set
Pry bar
Jack stands
Coil spring
Hoist
Work order
Shop manual

ENABLING OBJECTIVES

1. Identify and use basic hand tools.
2. Read and interpret shop manual.

RESOURCE

Mitchell Automechanics, p. 530.

TEACHING ACTIVITIES

1. Discuss coil spring applications and use.
2. Discuss coil spring service safety precautions.
3. Show students front and rear coil spring suspension systems.
4. Have students list steps used when replacing coil springs.
5. Demonstrate coil spring removal and replacement on a vehicle.
6. Have students remove and replace coil springs on a vehicle.

PERFORMANCE OBJECTIVE 12

CRITERION-REFERENCED MEASURE

Questions

1. In use, one end of the coil spring rests on the frame and the other end rests on
   a. the steering knuckle.
   b. the axle or suspension member.
   c. the steering linkage.
   d. neither of the above.

2. What is meant by the term, unsprung weight?
   a. the components suspended above the spring.
   b. the components mounted below the spring.
   c. neither of the above.

3. The MacPherson strut suspension system uses
   a. leaf springs.
   b. coil springs.
   c. torsion bars.

Answers

1. b
2. b
3. b

Practical Application

Have students remove and replace coil springs.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 12 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 12

REMOVING AND REPLACING COIL SPRINGS

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Listed all parts used.		
3. Raised vehicle and supported at frame with jack stands. CAUTION: Scotched rear wheel and set brake.		
4. Placed support jack under control arm.		
5. Removed wheel.		
6. Removed shocks.		
7. Compressed spring. CAUTION: Spring can slip out and kill.		
8. Removed ball joint nuts.		
9. Separated ball joints from spindle.		
10. Removed old spring.		
11. Removed old spring from compression. CAUTION: Spring can slip out and kill.		
12. Placed new spring in compressor.		
13. Put coil spring into place.		
14. Reattached control arm to spindle.		
15. Removed spring compressor.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 12

REMOVING AND REPLACING COIL SPRINGS

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
16. Replaced shock absorber.		
17. Replaced wheel. Wheel lugs must be torqued to manufacturer's specifications.		
18. Lowered vehicle.		
19. Road tested and returned to service.		

APPROVED: YES _____ NO ____

_____

Evaluator's Signature **Date**

DUTY MAINTAINING SUSPENSION

PERFORMANCE OBJECTIVE 13

TASK

Remove and replace king pins.

STANDARD OF PERFORMANCE OF TASK

There can be no play; king pins must be properly aligned.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK:

Torch
Hammer
Basic hand tool set
Jack stand
King pin
Hoist
Work order
Shop manual

ENABLING OBJECTIVES

1. Identify suspension system types.
2. Read and interpret manufacturer's procedures.
3. Know safety precautions when using heating torch.

RESOURCE

Mitchell Automechanics, pp. 536-37.

TEACHING ACTIVITIES

1. Discuss solid front axle and Twin I-Beam suspension systems.
2. Show vehicle with king pin suspension system.
3. Demonstrate king pin wear checking procedures.
4. Have students locate in shop manual the king pin replacement procedure and list the steps required.
5. Demonstrate king pin and bushing replacement on a vehicle.
6. Have student remove and replace king pins and bushings on a specific vehicle.

PERFORMANCE OBJECTIVE 13

CRITERION-REFERENCED MEASURE

Questions

1. On a solid axle front suspension vehicle, what part or parts secures the spindle to the axle?
   a. spindle arm
   b. king pin and spindle bolt locking pin
   c. lower control arm
   d. strut rod

2. On a Ford Twin I-Beam suspension system, the king pin bushing must be
   a. pressed in and out using an arbor press.
   b. reamed to size after installation.
   c. pushed in by hand and reaming is not required.
   d. neither of the above

3. On solid axle type suspensions, what are the most common type springs used?
   a. coil springs
   b. leaf springs
   c. torsion bars
   d. none of the above

Answers

1. b
2. c
3. a

Practical Application

Have students remove and replace king pins.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 13 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 13

REMOVING AND REPLACING KING PINS

Student's Name _____ **Date** _____

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. Score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting item. NOTE: Listed all parts used.		
3. Raised front of vehicle.		
4. Placed jack stands under axle.		
5. Removed wheels.		
6. Removed brake assembly and backing plate assembly.		
7. Knocked tie rod loose.		
8. Removed grease caps.		
9. Removed center support bolt (lock).		
10. Removed king pins. NOTE: It may be necessary to remove king pins using heat.		
11. Removed spindle.		
12. Removed bushings from spindle.		
13. Installed new bushings on spindle.		
14. Machined bushing to fit king pins.		
15. Installed spindle assembly.		
16. Installed king pins and king pin locks.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 13

REMOVING AND REPLACING KING PINS

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
18. Installed backing plate assembly.		
19. Replaced tie rod end.		
20. Replaced wheel.		
21. Lowered vehicle and returned to service.		
22. Road tested. NOTE: It is sometimes necessary to bleed brakes.		
23. Checked brake lines; tightened and bled where necessary.		
17. Installed grease caps and lubricated to manufacturer's specifications.		

APPROVED: YES _____ NO _____

Evaluator's Signature _____ Date _____

DUTY MAINTAINING SUSPENSION

PERFORMANCE OBJECTIVE 14

TASK

Remove and replace spindle.

STANDARD OF PERFORMANCE OF TASK

All bolts must be torqued to manufacturer's specifications; when alignment is checked, wheels must be at manufacturer's specifications; and all parts must be lubricated to manufacturer's specifications.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Basic hand tool set
Hoist
Safety pins
Spindle
Work order
Shop manual

ENABLING OBJECTIVES

1. Identify suspension system components.
2. Read and interpret shop manual.

RESOURCE

Mitchell Automechanics, pp. 533-37.

TEACHING ACTIVITIES

1. Discuss the role that the spindle plays in the operation of ball joint suspension systems.
2. Explain camber-steering axis inclination as it relates to the design of the spindle.
3. Have students draw a sketch representing the camber-steering axis inclination built in the spindle.
4. Demonstrate removal and replacement of a spindle.
5. Have students list the steps required to replace a spindle.
6. Have students remove and replace a spindle on a specific vehicle.

PERFORMANCE OBJECTIVE 14

CRITERION-REFERENCED MEASURE

Questions

1. What two steering angles are designed in the spindle?
   a. toe-in and caster
   b. camber and steering axis inclination
   c. camber and caster

2. The steering arm, which is a part of the spindle assembly, controls what angle during the operation of a vehicle?
   a. toe-out on turns
   b. camber
   c. caster

3. A vehicle has a bent spindle. Mechanic "A" says to straighten it, while Mechanic "B" says to replace it. Who is right?
   a. Mechanic "A"
   b. Mechanic "B"
   c. neither Mechanic "A" nor "B"

Answers

1. b
2. a
3. b

Practical Application

Have students remove and replace spindle.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 14 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 14

REMOVING AND REPLACING SPINDLE

Student's Name _____ **Date** _____

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Listed all parts used.		
3. Raised and supported vehicle.		
4. Raised and supported lower control arms.		
5. Removed wheel assembly.		
6. Removed brake assembly and backing plate.		
7. Separated tie rod end.		
8. Removed ball joint nuts.		
9. Separated spindle from ball joints.		
10. Replaced spindle and attached to ball joint.		
11. Replaced ball joint nuts.		
12. Tightened tie rod ends.		
13. Replaced brake assembly and backing plate.		
14. Replaced wheel assembly.		
15. Removed support from lower control arm.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 14

REMOVING AND REPLACING SPINDLE

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
16. Lowered vehicle and road tested.		
17. Returned vehicle to service.		

APPROVED: YES _____ NO ____

_____

Evaluator's Signature **Date**

DUTY MAINTAINING SUSPENSION

PERFORMANCE OBJECTIVE 15

TASK

Remove and replace MacPherson strut assembly.

STANDARD OF PERFORMANCE OF TASK

All bolts must be torqued to manufacturer's specifications; when alignment is checked, wheel alignment must meet manufacturer's specifications.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Basic hand tool set
MacPherson strut assembly
Safety pins
Work order
Spring compressor
Shop manual

ENABLING OBJECTIVES

1. State safety precautions with use of special tools.
2. Identify suspension system components.

RESOURCE

Mitchell Automechanics, pp. 534-36.

TEACHING ACTIVITIES

1. Discuss MacPherson strut suspension systems.
2. Explain safety precautions when using coil spring compressors.
3. Demonstrate replacement of MacPherson strut assembly and alignment correction.
4. Have students list steps for replacement of a MacPherson strut assembly and alignment correction procedures.
5. Have students replace a MacPherson strut assembly on a specific vehicle and make alignment correction.

PERFORMANCE OBJECTIVE 15

CRITERION-REFERENCED MEASURE

Questions

1. A vehicle with MacPherson strut front suspension has all of the components of a vehicle with independent front suspension except the
   a. torsion bar.
   b. stabilizer bar.
   c. upper control arm.

2. Inward and outward movement at the top of the MacPherson strut would change which alignment angle?
   a. caster
   b. toe-in
   c. camber

3. A vehicle has a bent MacPherson strut, the proper repair procedure would be to
   a. heat and straighten.
   b. use hydraulic power jack to straighten.
   c. replace.

Answers

1. c
2. c
3. c

Practical Application

Have students remove and replace MacPherson strut assembly.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 15 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 15

REMOVING AND REPLACING MACPHERSON STRUT ASSEMBLY

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Listed all parts used.		
3. Raised and supported vehicle from front.		
4. Removed wheel.		
5. Raised hood.		
6. Removed brake hose retaining bolt. NOTE: Safety position brake line.		
7. Removed upper and lower mounting bolts.		
8. Installed new strut assembly.		
9. Replaced upper and lower mounting bolts.		
10. Replaced brake hose retaining bolt.		
11. Replaced wheel, torqued to manufacturer's specifications.		
12. Checked alignment.		
13. Lowered vehicle.		
14. Road tested and returned to service.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY MAINTAINING SUSPENSION

PERFORMANCE OBJECTIVE 16

TASK

Replace MacPherson strut assembly cartridge.

STANDARD OF PERFORMANCE OF TASK

Rebuilt strut must not leak; all bolts must be torqued to manufacturer's specifications; and replacement fluid must meet manufacturer's specifications.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Basic hand tool set
MacPherson strut assembly
Safety pins
Work order
Strut compressor
Shop manual

ENABLING OBJECTIVES

1. Identify components within a specific suspension system.
2. Read and interpret shop manual.

RESOURCE

Mitchell Automechanics, pp. 534-36.

TEACHING ACTIVITIES

1. Discuss hydraulic operation of a MacPherson strut.
2. Explain hydraulic fluid quality and quantity requirements.
3. Discuss safety precautions during removal and installation of snap rings.
4. Have students locate, in shop manual, cartridge replacement procedures.
5. Demonstrate MacPherson strut cartridge replacement.
6. Have students replace MacPherson strut cartridge on a specific vehicle.

PERFORMANCE OBJECTIVE 16

CRITERION-REFERENCED MEASURE

Questions

1. The MacPherson strut cartridge or shock absorber within the strut assembly serves what two purposes?
   a. controls vehicle ride height and maintains proper wheel alignment
   b. controls road shock and maintains proper wheel alignment
   c. controls toe-out on turns and controls body side thrust

2. A hydraulic fluid leak at the rod end of a MacPherson strut indicates a
   a. normal condition.
   b. replacement is indicated.
   c. neither a nor b.

3. All MacPherson strut suspension systems have replacement cartridges.
   a. yes
   b. no

Answers

1. b
2. b
3. b

Practical Application

Have students replace MacPherson strut assembly cartridge.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 16 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 16

REPLACING MCPHERSON STRUT ASSEMBLY CARTRIDGE

Student's Name _____ **Date** _____

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order. NOTE: Listed all parts used.		
2. Recorded starting time.		
3. Placed MacPherson strut on bench.		
4. Compressed spring. CAUTION: Do not let spring slip. It can injure.		
5. Removed top retainer cap.		
6. Replaced necessary seals.		
7. Installed cartridge to manufacturer's specifications.		
8. Replaced spring.		
9. Replaced retainer cap.		
10. Removed spring compressor.		

APPROVED: YES _____ NO _____

Evaluator's Signature _____ **Date** _____

DUTY MAINTAINING SUSPENSION

PERFORMANCE OBJECTIVE 17

TASK

Remove and replace trunnion pin assembly.

STANDARD OF PERFORMANCE OF TASK

All bolts must be torqued to manufacturer's specifications; when alignment is rechecked, wheels must meet manufacturer's specifications.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Talmon press tool
Rack
Basic hand tool set
Torch
Hammer
Trunnion
Hoist
Work order
Shop manual

ENABLING OBJECTIVES

1. Read and interpret shop manual.
2. Identify and use basic hand tools.

RESOURCE

Motor's Auto Repair Manual, pp. 1133-37.

TEACHING ACTIVITIES

1. Review torque wrench use and operation.
2. Discuss suspension systems using trunnions instead of ball joints.
3. Review heating torch operations and safety precautions.
4. Have students list trunnion pin replacement procedures as specified by vehicle manufacturer.
5. Demonstrate proper procedure for replacement of trunnion pin assembly using the talon press tool.
6. Have students remove and replace a trunnion pin assembly on a specific vehicle.

PERFORMANCE OBJECTIVE 17

CRITERION-REFERENCED MEASURE

Questions

1. A trunnion pin assembly serves the same task within the front suspension as the
   a. coil spring.
   b. ball joint.
   c. control arm.
   d. steering knuckle assembly.

2. The trunnion pin assembly provides a _____ for the upper control arm assembly.
   a. caster adjustment
   b. pivot point
   c. spring support
   d. none of the above

3. The transmission of road noise through the coil spring is minimized by what method?
   a. insulating the springs from the body with rubber cushions
   b. the usage of radial tires and low tire pressure
   c. by mounting the coil spring ridged to the body of the vehicle
   d. none of the above

Answers

1. b
2. b
3. a

Practical Application

Have students remove and replace trunnion pin assembly.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 17 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 17

REMOVING AND REPLACING TRUNNION PIN ASSEMBLY

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Listed all parts used.		
3. Raised and supported vehicle.		
4. Removed wheel.		
5. Removed brake assembly and backing plate.		
6. Placed support bar under coil spring.		
7. Removed trunnion pin using special press tool.		
8. Replaced trunnion pin.		
9. Removed support bar.		
10. Replaced backing and brake assembly.		
11. Replaced wheel and tightened to manufacturer's specifications.		
12. Checked alignment.		
13. Lowered vehicle.		
14. Road tested.		
15. Returned to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING SUSPENSION

PERFORMANCE OBJECTIVE 18

TASK

Remove and replace leaf spring assembly.

STANDARD OF PERFORMANCE OF TASK

Vehicle must be returned to correct spring height.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Basic hand tool set
Stand
Rack
Hammer
Air wrench
Pry bar
Torch
Leaf spring assembly
Work order
Shop manual

ENABLING OBJECTIVES

1. Identify various leaf spring suspension systems and their applications.
2. List safety precautions associated with leaf spring service.

RESOURCE

Mitchell Automechanics, pp. 536-39.

TEACHING ACTIVITIES

1. Discuss front, rear and transverse leaf spring suspension systems.
2. Explain safety precautions with leaf spring service.
3. Have students locate, in shop manual, leaf spring replacement procedures.
4. Demonstrate leaf spring replacement on a vehicle.
5. Have students replace a leaf spring assembly on a specific vehicle.

PERFORMANCE OBJECTIVE 18

CRITERION-REFERENCED MEASURE

Questions

1. The leaf spring shackle allows the spring to
   a. be held rigid (prevent flexing).
   b. stretch out straight when it flexes.
   c. control side sway of the chassis.

2. What type of springs do solid axle, front suspension, vehicles usually have?
   a. coil springs
   b. torsion bars
   c. leaf springs

3. The two main functions of the leaf spring on a vehicle with rear wheel drive is to
   a. suspend vehicle weight and transmit the driving force from the rear wheels to the frame.
   b. suspend vehicle weight and control road shock.
   c. control wheel base length and adjust tread width.

Answers

1. b
2. c
3. a

Practical Application

Have students remove and replace leaf spring assembly.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 18 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 18

REMOVING AND REPLACING LEAF SPRING ASSEMBLY

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Listed all parts used.		
3. Raised and supported vehicle by frame.		
4. Removed wheel.		
5. Removed shackel bolts.		
6. Removed "U" bolts. CAUTION: Leaf spring assembly may fall causing injury. Get help to remove spring assembly.		
7. Replaced leaf spring assembly.		
8. Replaced "U" bolts and tightened.		
9. Replaced shackle bolts.		
10. Replaced wheel.		
11. Lowered vehicle.		
12. Road tested and returned to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING SUSPENSION

PERFORMANCE OBJECTIVE 19

TASK

Remove and replace spring hangers.

STANDARD OF PERFORMANCE OF TASK

All nuts and bolts must be torqued to manufacturer's specifications; after spring hangers have been replaced, ride height must meet manufacturer's specifications.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK:

Basic hand tool set
Stand
Rack
Hammer
Air wrench
Pry bar
Torch
Spring hanger
Work order
Shop manual

ENABLING OBJECTIVES

1. Identify and use basic hand tools.
2. Read and interpret shop manual.

RESOURCE

Mitchell Automechanics, pp. 536-39.

TEACHING ACTIVITIES

1. Explain role spring hangers serve on semi-elliptical leaf springs.
2. Discuss procedures for checking vehicle ride height.
3. Have students list procedures for leaf spring bushing and hanger replacement.
4. Demonstrate spring bushing and hanger replacement.
5. Have students remove and replace spring hanger on a specific vehicle.

PERFORMANCE OBJECTIVE 19

CRITERION-REFERENCED MEASURE

Questions

1. The length of the leaf spring hanger can
   a. control the vehicle ride height.
   b. raise vehicle ride height and change alignment (caster) settings.
   c. both a & b.
   d. neither a nor b.

2. Spring hangers are located where on a rear wheel drive vehicle?
   a. rear of the spring
   b. front of the spring
   c. center of the spring

3. Transverse mounted leaf springs means they are
   a. mounted parallel with wheels.
   b. mounted parallel with axle.
   c. mounted parallel with shock absorber.

Answers

1. c
2. a
3. b

Practical Application

Have students remove and replace spring hangers.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 19 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 19

REMOVING AND REPLACING HANGERS

Student's Name _____ **Date** _____

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Listed all parts used.		
3. Raised vehicle and supported at frame.		
4. Placed support jack under spring.		
5. Applied slight pressure to spring.		
6. Removed spring hanger and replaced with new.		
7. Removed support jack from spring.		
8. Removed frame support and lowered vehicle.		
9. Checked ride height and adjusted if needed.		
10. Returned vehicle to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature _____ **Date** _____

DUTY MAINTAINING SUSPENSION

PERFORMANCE OBJECTIVE 20

TASK

Remove and replace I-beam.

STANDARD OF PERFORMANCE OF TASK

All nuts and bolts must be torqued to manufacturer's specifications; ride height must meet manufacturer's specifications.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Hoist
Work order
Basic hand tool set
Pry bar
Shop manual

ENABLING OBJECTIVES

1. Locate I-beam suspension components.
2. Identify basic hand tools and shop equipment.

RESOURCE

Mitchell Automechanics, pp. 536-37.

TEACHING ACTIVITIES

1. Discuss solid front axle suspension and twin I-beam suspension systems.
2. Discuss vehicle ride height and methods of adjustment.
3. Have students prepare a list of the steps required for I-beam removal and reinstallation.
4. Demonstrate method of I-beam replacement.
5. Have students remove and replace an I-beam and check vehicle ride height.

PERFORMANCE OBJECTIVE 20

CRITERION-REFERENCED MEASURE

Questions

1. Front-end alignment on a vehicle with twin I-beam suspension costs more because
   a. I-beams must be replaced if realignment is required.
   b. I-beams must be twisted or bent when realignment is required.
   c. each realignment requires replacement of the front coil springs.

2. The correction for improper ride height on a twin I-beam suspension vehicle is usually a replacement of the
   a. coil springs.
   b. I-beams.
   c. shock absorbers.
   d. none of the above.

3. The advantages of the twin I-beam suspension system are
   a. strength and simplicity.
   b. eliminates the rolling tendency of the single solid axle.
   c. allows the vehicle to have the strength of a solid axle suspension and the ride of an independent suspension.
   d. none of the above.
   e. a, b & c.

Answers

1. b
2. a
3. e

Practical Application

Have students remove and replace I-beam.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 20 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 20

REMOVING AND REPLACING I-BEAM

Student's Name _____ **Date** _____

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Listed all parts used.		
3. Raised front of vehicle and supported I-beam on jack stands.		
4. Removed wheel, front only.		
5. Removed brake assembly and backing plate.		
6. Removed king pin.		
7. Swung spindle out of way.		
8. Removed lower shock belt.		
9. Removed lower spring nut.		
10. Removed upper spring retaining bolt.		
11. Raised vehicle off stands.		
12. Removed spring.		
13. Removed radius arm attaching bolt from I-beam.		
14. Removed bolt from small end of I-beam.		
15. Removed I-beams.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 20

REMOVING AND REPLACING I-BEAM

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
16. Put new I-beam in place and bolted into place.		
17. Replaced radius arm attaching bolts to I-beam.		
18. Replaced spring.		
19. Lowered vehicle.		
20. Replaced upper spring attaching bolts.		
21. Replaced lower spring nut.		
22. Replaced lower spring bolt.		
23. Returned spindle to original position.		
24. Replaced king pin assembly, lubricated to manufacturer's specifications.		
25. Attached backing plated and brake assembly.		
26. Replaced wheel.		
27. Removed jack stands and lowered vehicle.		
28. Checked alignment and test drove.		
29. Returned vehicle to service.		

APPROVED: YES _____ NO _____

_____

Evaluator's Signature Date

DUTY MAINTAINING SUSPENSION

PERFORMANCE OBJECTIVE 21

TASK

Remove and replace stabilizer and stabilizer bushings.

STANDARD OF PERFORMANCE OF TASK

All nuts and bolts must be torqued to manufacturer's specifications; all worn bushings must be replaced; and ride height must be set according to manufacturer's specifications.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Basic hand tool set
Rack
Air wrench
Pry bar
Torch
Hoist
Bar and bushing
Stabilizer
Work order
Shop manual

ENABLING OBJECTIVES

1. Identify and use basic hand tools.
2. Read and interpret work order.

RESOURCE

Mitchell Automechanics, pp. 352-33.

TEACHING ACTIVITIES

1. Discuss stabilizer bar functions and features.
2. Discuss the use of special tools and safety precautions.
3. Have students draw a typical stabilizer bar and link bushings, labeling each component.
4. Review vehicle ride height checking procedure.
5. Demonstrate proper procedures for stabilizer bar and bushing replacement.
6. Have students remove and replace stabilizer bar and bushings on a specific vehicle.

PERFORMANCE OBJECTIVE 21

CRITERION-REFERENCED MEASURE

Questions

1. Stabilizer bars help in controlling
   a. vehicle ride height.
   b. spring action.
   c. caster and camber adjustments.
   d. none of the above.

2. When replacing a stabilizer bar or bushings, the vehicle should be in what position?
   a. level
   b. one side of the vehicle higher than the other side
   c. vehicle weight off the tire and wheel assembly and in a level position
   d. none of the above

3. When one side of the frame rises on a vehicle, as in a bump, the opposite side of the frame also rises. This movement is counteracted by what suspension component?
   a. spring
   b. control arm
   c. stabilizer bar
   d. none of the above

Answers

1. b
2. c
3. c

Practical Application

Have students remove and replace stabilizer and stabilizer bushings.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 21 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 21

REMOVING AND REPLACING STABILIZER AND STABILIZER BUSHINGS

Student's Name _____ **Date** _____

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Listed all parts used.		
3. Raised vehicle and set jack stands.		
4. Removed both end links.		
5. Removed both inner support brackets.		
6. Replaced bushing.		
7. Replaced inner support brackets.		
8. Replaced both end links.		
9. Lowered vehicle.		
10. Checked ride height, must meet manufacturer's specifications.		
11. Road tested and returned to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature _____ **Date** _____

MAINTAINING STEERING SYSTEM

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 22

TASK

Inspect steering gear and linkage.

STANDARD OF PERFORMANCE OF TASK

All worn or damaged parts must be found and noted.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Rack
Basic hand tool set
Pry bar
Channel Locks (16")
Hoist
Work order
Shop manual

ENABLING OBJECTIVES

1. Interpret linear measurements.
2. Evaluate and compare with vehicle manufacturer's specifications.

RESOURCE

Mitchell Automechanics, pp. 544-52.

TEACHING ACTIVITIES

1. Discuss steering gear and linkage wear areas to be inspected.
2. Show how to perform inspection procedures.
3. Have students prepare a specification and checking procedure sheet for a specific vehicle.
4. Demonstrate on a vehicle the proper checking procedure, pointing out specific or critical areas.
5. Have students inspect and Identify damaged or worn steering gear and linkage.

PERFORMANCE OBJECTIVE 22

CRITERION-REFERENCED MEASURE

Questions

1. Name three components in a basic steering linkage.
   _____, _____, and _____

2. Excessive play within a recirculating ball steering gear could be caused by
   a. excessive sector shaft clearance (lash adjustment) or worn internal parts.
   b. excessive pitman arm to sector shaft clearance.
   c. low lubricant level.
   d. none of the above.

3. Excessive play (movement of the steering wheel) should be checked with the vehicle
   a. tire and wheel assemblies off the floor.
   b. weight on the tire and wheel assemblies.
   c. steering gear and linkage removed.
   d. none of the above.

Answers

1. Relay rod (center link), tie rod or tie rod end, pitman arm, idler arm
2. a
3. b

Practical Application

Have students inspect steering gear and linkage.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 22 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 22

INSPECTING STEERING GEAR AND LINKAGE

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Listed all parts used.		
3. Raised and supported vehicle.		
4. Checked wheel bearing for play.		
5. Checked tie-rod ends for excessive play.		
6. Using bar, checked ball joints. NOTE: It is necessary to refer to service manual for different methods of inspection.		
7. Checked steering gear play.		
8. Inspected pitman arm.		
9. Inspected drag (center) link.		
10. Inspected idler arm.		
11. Noted all damaged parts on work order.		
12. Lowered vehicle and test drove.		
13. Returned to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 23

TASK

Check and service fluid level.

STANDARD OF PERFORMANCE OF TASK

Fluid level and fluid type must meet manufacturer's specifications.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Brake Fluid
Power steering fluid
Basic hand tool set
Work order
Shop manual.

ENABLING OBJECTIVES

1. Read and interpret manufacturer's specifications.
2. Identify basic steering fluids and lubricants.

RESOURCE

Mitchell Automechanics, pp. 105, 551-53.

TEACHING ACTIVITIES

1. Discuss and explain hydraulic principles as they relate to power assisted steering lubricants and level checking procedures.
2. Explain manual steering lubricants and level checking procedures.
3. Have students locate in shop manual, manual and power steering checking procedures.
4. Discuss power steering fluid flushing procedures.
5. Have students check and service steering fluid level on a specific vehicle.

PERFORMANCE OBJECTIVE 23

CRITERION-REFERENCED MEASURE

Questions

1. A whining noise in a power steering pump, when the steering wheel is turned, usually indicates a
   a. slipping pump drive belt.
   b. low reservoir fluid level.
   c. defective pump assembly.
   d. none of the above .

2. Heavy steering effort (poor or loss of assist) could be caused by
   a. defective or loose pump drive belt.
   b. low pump fluid level.
   c. defective center support bearing.
   d. a & b.
   e. None of the above.

3. Discolored or separated fluid in a vehicle p/s pump reservoir must be
   a. removed and system flushed and new fluid added.
   b. checked and fluid level corrected.
   c. disassembled and inspected for worn parts.
   d. none of the above.

Answers

1. b
2. d
3. a

Practical Application

Have students check and service fluid level.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 23 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 23

CHECKING AND SERVICING FLUID LEVEL

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Raised hood.		
3. Removed reservoir cap.		
4. Checked fluid. NOTE: If fluid is discolored or separated, flush system with new fluid and replace .		
5. Replaced cap.		
6. Closed hood.		
7. Checked steering operation.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 24

TASK

Lubricate steering gear and linkage.

STANDARD OF PERFORMANCE OF TASK

Gear grease used must meet manufacturer's specifications; there can be no excess grease showing externally.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Grease gun
Rack
Basic hand tool set
Towels
Work order
Shop manual

ENABLING OBJECTIVES

1. Identify basic lubricating equipment.
2. Read and interpret manufacturer's service manual.

RESOURCE

Mitchell Automechanics, pp. 106, 547-48 .

TEACHING ACTIVITIES

1. Discuss manufacturer's lubricant (grease) recommendation for steering gears and suspension systems.
2. Explain lubricant sealing methods used on steering linkage components.
3. Have students locate manufacturer's lubrication specifications in shop manuals or charts.
4. Demonstrate steering gear and linkage lubrication procedures.
5. Have students lubricate steering gear and linkage on a specific vehicle.

PERFORMANCE OBJECTIVE 24

CRITERION-REFERENCED MEASURE

Questions

1. After lubricating a steering linkage component, grease continues to ooze from the grease fitting, you should
   a. not be concerned about it.
   b. replace the grease (zerk) fitting.
   c. replace the linkage component.
   d. none of the above.

2. On vehicles that have plugs in the steering linkage components, what should be done to lubricate them?
   a. replace the plug with zerk fitting and lubricate.
   b. replace the plug with a zerk fitting, lubricate and reinstall the plug.
   c. remove the plug, lubricate with special tip and reinstall plug.
   d. none of the above.
   e. b & c.

3. Manual steering gears usually are lubricated with
   a. multi-purpose grease.
   b. SAE 30 oil.
   c. SAE 80 w-90 lubricant.
   d. none of the above.

Answers

1. b
2. e
3. a

Practical Application

The students will lubricate steering gear and linkage according to manufacturer's specifications.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 24 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 24

LUBRICATING STEERING GEAR AND LINKAGE

Student's Name _____ Date _____

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Listed all parts used.		
3. Raised hood.		
4. Removed grease plug from steering box. CAUTION: Only manual steering autos have grease plugs. Models having power steering will not have grease plug.		
5. Checked for water contamination of grease.		
6. Returned lube to proper level. NOTE: See manufacturer's specifications for lube type.		
7. Greased tie rod ends, drag linkage, ball joints, idler arms. NOTE: Changed any grease plugs that were damaged.		

APPROVED: YES _____ NO _____

Evaluator's Signature _____ Date _____

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 25

TASK

Rotate tires.

STANDARD OF PERFORMANCE OF TASK

All lug nuts must be torqued to manufacturer's specifications; correct rotation order must be followed according to manufacturer's specifications; and radials must not be crisscrossed.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Rack
Air wrench
Basic hand tool set
Screwdriver
Penetrating fluid
Rubber mallet
Work order
Shop manual

ENABLING OBJECTIVES

1. Identify process of correct tool operation.
2. Interpret manufacturer's recommendations.

RESOURCE

Mitchell Automechanics, pp. 107-08.

TEACHING ACTIVITIES

1. Discuss radial and bias-belted tires and manufacturer's rotation recommendations.
2. Have students locate recommended tire rotation procedures in shop manual or chart.
3. Discuss proper wheel nut torque methods.
4. Demonstrate methods of tire rotation and wheel nut torque procedure.
5. Have students rotate tires and torque wheel nuts on a specific vehicle.

PERFORMANCE OBJECTIVE 25

CRITERION-REFERENCED MEASURE

Questions

1. Tire rotation should be done how often for maximum tire mileage?
   a. every 10,000 miles
   b. every 5,000 miles
   c. every 15,000 miles

2. The four important factors that govern tire life are _____, _____, _____, and _____.

3. How much more tire life can be obtained if the tires are rotated at regular intervals?
   a. 20%
   b. 40%
   c. 5%

Answers

1. b
2. pressure, rotation, balance and alignment.
3. a

Practical Application

Have students rotate tires.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 25 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 25

ROTATING TIRES

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. As score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Raised and supported vehicle.		
3. Marked each tire for proper relocation. CAUTION: Before relocating tires, checked manufacturer's specification for rotation order. Do not crisscross radials.		
4. Rotated tires. All wheel lugs must be torqued to manufacturer's specifications.		
5. Lowered vehicle and returned to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 26

TASK

Balance wheel and tire assembly.

STANDARD OF PERFORMANCE OF TASK

When driven, there can be no vibrations due to unbalanced tires.

SOURCE OF STANDARD

Writing Team of Incumbent Worker

CONDITIONS FOR PERFORMANCE OF TASK

Rack
Air wrench
Penetrating fluid
Rubber mallet
Wheel balancing equipment (dynamic and spin)
Weights
Basic hand tool set
Replacement
Worker order
Shop manual

ENABLING OBJECTIVES

1. Recall wheel balancer operation.
2. Identify and describe special tools.

RESOURCE

Mitchell Automechanics, pp. 107-08, 558.

TEACHING ACTIVITIES

1. Discuss wheel balance and unbalance; static (or kinetic) and dynamic unbalance.
2. Describe weight measurements as they relate to wheel weight selection and tire balance.
3. Review on and off car wheel balancer operation and safety precautions.
4. Have students list the conditions that can be caused by an unbalanced tire and wheel assembly.
5. Demonstrate proper procedures for balancing tire and wheel assembly on and off the vehicle.
6. Have students balance a tire and wheel assembly, on and off a specific vehicle.

PERFORMANCE OBJECTIVE 26

CRITERION-REFERENCED MEASURE

Questions

1. Tires that are not balanced will _____ faster and transmit _____ to the steering wheel.

2. A tire and wheel assembly which is statically unbalanced will
   a. create bald spots on the tread surface.
   b. cause the vehicle to vibrate or shake.
   c. reduce tire life.
   d. all of the above.
   e. none of the above.

3. A tire and wheel assembly which is statically and dynamically unbalanced will
   a. cause the tire and wheel assembly to bounce or wobble.
   b. reduce tire life.
   c. reduce stopping distance.
   d. none of the above.
   e. both a & b.

Answers

1. wear, vibration
2. d
3. e

Practical Application

Have students balance wheel and tire assembly.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 26 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 26

BALANCING WHEEL AND TIRE ASSEMBLY

Student's Name _____ **Date** _____

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
(OFF CAR BALANCE):		
1. Obtained work order. NOTE: List all parts used.		
2. Raised and supported vehicle.		
3. Removed wheel and tire assembly from vehicle.		
4. Removed all old wheel weights and dirt from rims.		
5. Placed wheel on wheel balancer.		
6. Balanced wheel and tire assembly. NOTE: Use same procedure on all wheel and tire assemblies.		
7. Replaced wheel assembly.		
8. Lowered vehicle, road tested and returned to service.		
(ON CAR BALANCE):		
1. Obtained work order.		
2. Placed vehicle on level work area.		
3. Raised vehicle.		
4. Removed wheel covers.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 26

BALANCING WHEEL AND TIRE ASSEMBLY

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
5. Removed all dirt from wheel and tire. CAUTION: Check tread carefully and remove all gravel, bits of metal, etc. Such matter can come loose and injure persons, also, foreign objects can cause a problem in the balancing process.		
6. Removed all wheel weights.		
7. Attached wheel balancing ring and balancing head to the wheel. CAUTION: Vehicles with locking differentials cannot be balanced using the on car wheel balancing method.		
8. Put wheel balance adapter inside flat position of wheel locked down.		
9. Installed wheel balancer or adapter on inner adapter and locked down. CAUTION: Be sure inside wheel balance is tight.		
10. Spun wheel.		
11. Adjusted weight adjustment knob until all vibration was gone.		
12. Added amount of weight shown on balancer. NOTE: Be sure to place equal amounts on each side.		
13. Removed wheel balancing rings and inside wheel adapter.		
14. Replaced wheel cover.		
15. When wheel balancing was completed, test drove vehicle and returned to service.		
16. Listed all parts on work order.		

APPROVED: YES _____ NO _____

_____

Evaluator's Signature Date

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 27

TASK

Adjust steering sector.

STANDARD OF PERFORMANCE OF TASK

All adjustments must be made according to manufacturer's specifications; steering wheel must be centered; there can be no play; and there can be no binding.

SOURCE OF STANDARD

Writing Team of Incumbent workers

CONDITIONS FOR PERFORMANCE OF TASK

Screwdriver
Work shop
Basic hand tool set
Shop manual

ENABLING OBJECTIVES

1. Read and interpret shop manual.
2. Identify basic hand tools.

RESOURCE

Mitchell Automechanics, pp. 544-50.

TEACHING ACTIVITIES

1. Discuss the major types of steering gears and operation.
2. Review the use of torque wrench as it relates to steering gear turning effort.
3. Have students locate in shop manuals the procedure for adjusting steering sector preload.
4. Demonstrate methods of adjusting sector shaft preload on various types of steering gears.
5. Have students perform the sector shaft adjustment on the steering gear of a specific vehicle.

PERFORMANCE OBJECTIVE 27

CRITERION-REFERENCED MEASURE

Questions

1. The sector shaft adjustment must be made with the worm shaft in what position?
   a. high point of steering
   b. worm shaft turned to the extreme left
   c. worm shaft turned to the extreme right

2. On the recirculating ball steering ear, the two adjustments that can be made are
   a. ball and nut preload.
   b. worm bearing preload and sector shaft preload.
   c. rack-piston nut preload and worm bearing preload.

3. Most vehicle manufacturers recommend that when steering gear adjustment is required the
   a. pitman arm be disconnected from the sector shaft.
   b. adjustment may be done without the removal of any attaching components.
   c. use of a torque wrench is necessary.
   d. a & c.

Answers

1. a
2. b
3. d

Practical Application

Have students adjust steering sector.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 27 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 27

ADJUSTING STEERING SECTOR

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time.		
3. Placed vehicle with wheel assemblies in straight ahead position.		
4. Raised hood.		
5. Loosened adjusting screw lock nut in steering gear box. Referred to service manual.		
6. Made adjustments.		
7. Tightened adjusting lock nut.		
8. Closed hood.		
9. Road tested and returned to service.		

APPROVED: YES ____ NO ____

Evaluator's Signature **Date**

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 28

TASK

Remove and replace steering linkage components.

STANDARD OF PERFORMANCE OF TASK

All nuts and bolts must be torqued to manufacturer's specifications; steering linkage components must be aligned to manufacturer's specifications.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Rack
Basic hand tool set
Air wrench
Penetrating fluid
Hammer
Tie rod remover
Grease gun
Safety pins
Replacement parts
Alignment equipment
Work order
Shop manual

ENABLING OBJECTIVES

1. Use basic hand and air tools.
2. Use lift (rack) or similar jacking device.
3. Use steering and linkage special tools.
4. Use shop manuals.
5. Interpret work orders.

RESOURCE

Crouse and Anglin. **Workbook for Automechanics**, p. 199.

TEACHING ACTIVITIES

1. Identify parts to be removed and replaced.
2. Explain the procedures used in removing and replacing steering linkage components.
3. Demonstrate the use of special tools used in removing and replacing steering linkage components.

PERFORMANCE OBJECTIVE 28

TEACHING ACTIVITIES (Continued)

4. Demonstrate how to remove and replace steering linkage components and inspect parts.
5. Have students remove and replace steering linkage components and inspect parts.
6. Discuss safe work habits with the students, using references of danger to the occupants as a result of sub-standard workmanship.
7. Emphasize the importance of proper toe-in.
8. Have students adjust toe-in according to manufacturer's specifications.

CRITERION-REFERENCED MEASURE

Questions

1. Steering knuckle arms are moved left to right through the use of what?
2. Where is the adjuster sleeve used in toe-in adjustment located?
3. The idler arm connects to the steering linkage and to what else?

Answers

1. steering linkages
2. between the tie rod ends
3. chassis

Practical Application

Have students remove and replace steering linkage components.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 28 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 28

REMOVING AND REPLACING STEERING LINKAGE COMPONENTS

Student's Name _____ **Date** _____

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time and listed parts used.		
3. Raised and supported vehicle.		
4. Removed wheel assemblies.		
5. Removed inner tie rod.		
6. Removed outer tie rod.		
7. Removed idler arm.		
8. Removed pitman arm.		
9. Removed relay rod (drag link, center link).		
10. Inspected all parts for wear and damage.		
11. Replaced worn parts.		
12. Attached idler arm and pitman arm to relay rod.		
13. Attached inner and outer tie rods.		
14. Lubricated all joints as necessary.		
15. Installed wheels. Torqued lube nuts to manufacturer's specifications.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 28

REMOVING AND REPLACING STEERING LINKAGE COMPONENTS

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
16. Lowered vehicle.		
17. Adjusted toe-in to specifications.		
18. Road tested and returned vehicle to service.		

APPROVED: YES _____ NO _____

_____

Evaluator's Signature Date

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 29

TASK

Remove and replace manual steering sector.

STANDARD OF PERFORMANCE OF TASK

All nuts and bolts must be torqued to manufacturer's specifications; all steering sector parts must be aligned to manufacturer's specifications.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Rack
Basic hand tool set
Air wrench
Pitman arm puller
Hammer
Grease gun
Work order
Shop manual

ENABLING OBJECTIVES

1. Use basic hand and air tools.
2. Use lift (rack) or similar jacking device.
3. Use steering and linkage tools.
4. Use shop manuals.
5. Interpret work orders.

RESOURCES

1. Stockel and Stockel. **Automechanics Fundamentals**, p. 412.
2. Crouse. **Automotive Mechanics,** 8th Edition, p. 540.
3. Crouse and Anglin. **Automotive Mechanics**, 9th Edition, p. 575.

TEACHING ACTIVITIES

1. Identify parts to be removed and replaced.
2. Explain steps in removing manual steering sector.
3. Demonstrate the use of special tools necessary to remove sector shaft.
4. Demonstrate the removal and replacement of the sector shaft and inspect parts.
5. Have students remove and replace sector shaft and inspect parts.
6. Emphasize the importance of proper sector shaft, worm gear centering.
7. Discuss gear tooth clearance adjustment importance.
8. Show the students the grease plug and identify proper lubricant and amount.
9. Have students adjust tooth clearance according to manufacturer's specifications.

PERFORMANCE OBJECTIVE 29

CRITERION-REFERENCED MEASURE

Questions

1. Where is the pitman arm located?
2. The sector shaft is rotated by which part of the steering gear?
3. To remove the pitman arm it is necessary to use a _____.

Answers

1. on the steering gear
2. worm gear
3. puller

Practical Application

Have students remove and replace a manual steering sector.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 29 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 29

REMOVING AND REPLACING MANUAL STEERING SECTOR

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time and listed parts used.		
3. Raised and supported vehicle and placed wheels straight ahead.		
4. Removed lower sector shaft nut.		
5. Removed pitman arm.		
6. Cleaned shaft.		
7. Removed sector shaft cover screws.		
8. Removed shaft assembly.		
9. Separated cover plate from shaft.		
10. Inspected and replaced parts as necessary.		
11. Aligned sector shaft center tooth with center of worm gear in housing.		
12. Replaced cover and torqued bolts to specifications.		
13. Greased unit.		
14. Road tested and returned to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 30

TASK

Remove and replace steering damper.

STANDARD OF PERFORMANCE OF TASK

All nuts and bolts must be torqued to manufacturer's specifications; there can be no binding of new parts.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Rack
Basic hand tool set
Air wrench
Penetrating fluid
Steering damper
Work order
Shop manual

ENABLING OBJECTIVES

1. Use basic hand tools.
2. Use (lift) rack or similar jacking device.
3. Use air wrench.
4. Use shop manuals.
5. Interpret work orders.

RESOURCE

1976 Chevrolet Passenger Car Service Manual, p. 9.

TEACHING ACTIVITIES

1. Identify steering damper or hydraulic stabilizer.
2. Identify bolts and nuts securing steering damper or (hydraulic stabilizer.
3. Demonstrate the removal of the steering damper (or the hydraulic stabilizer) and replace.
4. Torque the bolts to manufacturer's specifications.
5. Show students how to inspect unit for leaks, worn bushing, etc.
6. Have students remove and replace the steering damper (or hydraulic stabilizer).
7. Demonstrate to students the correct procedure for checking steering limits and what can be done to correct it.
8. Have students check steering limits and correct if needed.

PERFORMANCE OBJECTIVE 30

CRITERION-REFERENCED MEASURE

Questions

1. What are steering limits?
2. What is the purpose of the steering damper or hydraulic stabilizer?
3. Steering dampers or hydraulic stabilizers are similar in construction and design to what other suspension component?

Answers

1. Steering limits are the amount of steering linkage that travel from right to left.
2. It helps to control or stabilize steering linkage.
3. a shock absorber.

Practical Application

Have students to remove and replace steering damper.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 30 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 30

REMOVING AND REPLACING STEERING DAMPER

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time and listed all parts used.		
3. Raised and supported vehicle.		
4. Removed bolts and nuts from steering damper.		
5. Replaced steering damper and torqued bolts.		
6. Checked steering limits.		
7. Lowered vehicle.		
8. Road tested and returned vehicle to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 31

TASK

Remove and replace power steering hoses.

STANDARD OF PERFORMANCE OF TASK

There can be no leaks; all hoses must be routed according to manufacturer's specifications.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Rack
Line wrenches
Hacksaw
Basic hand tool set
Replacement hose (s)
Shop manual
Work order

ENABLING OBJECTIVES

1. Use basic hand and air tools.
2. Use lift (rack) or similar jacking device.
3. Use line wrenches (flare nut).
4. Use shop manuals.
5. Interpret work orders.

RESOURCES

1. **1985 Chrysler Corporation Service Manual**, Engine/Chassis/Body, p. 19-13.
2. **1984 Chrysler Corporation Service Manual**, Front Wheel Drive/Chassis/Body, p. 19-13.
3. Toboldt, Johnson and Olive. **Automotive Encyclopedia,** pp. 585-86.
4. Duffy. **Modern Automotive Mechanics,** pp. 873, 883.

TEACHING ACTIVITIES

1. Identify hose (s) to be removed.
2. Explain the importance of using line wrenches to loosen fittings (corners are easy to round off).
3. Demonstrate procedures used in removing hoses.
4. Discuss the dangers of flash fires on hot engines.
5. Discuss the dangers to skin if subjected to fluid for long periods of time.

PERFORMANCE OBJECTIVE 31

TEACHING ACTIVITIES (Continued)

6. Reinstall hoses; discuss the importance of using line wrenches to tighten lines.
7. Demonstrate procedure used to refill system and purge.
8. Have students remove and replace lines and purge system.

CRITERION-REFERENCED MEASURE

Questions

1. Why is it necessary to tie a rag around both ends of the power steering hose?
2. Why is it necessary to use line wrenches when removing or replacing power steering hoses?
3. What does purge the power steering system mean?

Answers

1. to reduce the possibility of flash fires
2. to prevent the rounding off of the nut (s)
3. to remove the air trapped in the system

Practical Application

Have students remove and replace power steering hose (s).

Method of Evaluating Practical Application

Use Checklist For Performance Objective 31 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 31

REMOVING AND REPLACING POWER STEERING HOSES

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time and list parts used.		
3. Opened hood.		
4. Raised and supported vehicle if necessary.		
5. Used line wrenches to remove hose ends.		
6. Observed safety rules regarding fluid. (Where applicable).		
7. Replaced hose (s).		
8. Refilled according to manufacturer's specifications.		
9. Purged system.		
10. Rechecked fluid.		
11. Lowered vehicle and hood.		
12. Road tested and returned to service.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 32

TASK

Remove and replace steering system belts and set tension.

STANDARD OF PERFORMANCE OF TASK

All worn or damaged belts must be replaced; tension must be set according to manufacturer's specifications; and belt must not slip.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Hoist
Basic hand tool set
Pry bar
Belts
Work order
Shop manual

ENABLING OBJECTIVES

1. Use basic hand tool set.
2. Use hoist (jack or rack) if needed.
3. Use pry bar.
4. Use shop manual.
5. Interpret work order.

RESOURCES

1. **1979 Oldsmobile Chassis Service Manual**, Section 3B, pp. 3-1 to 3-2.
2. Stockel and Stockel. **Auto Service and Repair,** pp.779-80.
3. Duffy. **Modern Automotive Mechanics,** p. 873.

TEACHING ACTIVITIES

1. Identify steering system belts.
2. Demonstrate how to loosen belt adjustments (and adjustment locations).
3. Demonstrate proper position for pry bar.
4. Demonstrate how to remove and replace belt(s).
5. Show student how to check and adjust tension.
6. Have students remove and replace belt(s).
7. Have students adjust belt tension according to manufacturer's specifications.

PERFORMANCE OBJECTIVE 32

CRITERION-REFERENCED MEASURE

Questions

1. Why is it important not to pry against the pump housing?
2. Why is it necessary to use a pry bar to loosen and tighten belt tension?
3. Why is it necessary to tighten belt tension to manufacturer's specifications?

Answers

1. It may crush the housing and cause damage or leakage.
2. for leverage purposes
3. to prevent pump/belt damage

Practical Application

Have students remove and replace steering system belts and set tension.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 32 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 32

REMOVING AND REPLACING STEERING SYSTEM BELTS AND SETTING TENSION

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time and listed all parts used.		
3. Raised hood.		
4. Loosened belt adjustment.		
5. Used suitable bar to loosen belt tension.		
6. Removed belt and replaced.		
7. Tightened belt tension according to manufacturer's specifications.		
8. Retightened adjustment bolt.		
9. Started engine and tested operation.		
10. Closed hood and returned vehicle to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 33

TASK

Remove and replace power steering cylinder.

STANDARD OF PERFORMANCE OF TASK

There can be no leaks; steering wheel must be centered.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Rack
Basic hand tool set
Line wrenches
Fluid
Power steering cylinder
Shop manual
Work order

ENABLING OBJECTIVES

1. Use basic hand tools.
2. Use lift rack or similar jacking device.
3. Use line wrenches.
4. Use shop manual.
5. Interpret work order.

RESOURCE

Motor's Auto Repair Manual, 1979, pp. 1-240.

TEACHING ACTIVITIES

1. Identify the type of steering system on which this unit is found.
2. Identify power steering cylinder.
3. Demonstrate the procedure used to remove and replace the steering cylinder.
4. Discuss the dangers of flash fires when fluid is subjected to extreme heat.
5. Discuss the dangers of allowing fluid to contact skin for long periods of time.
6. Demonstrate the proper procedure for refilling reservoir and purging system according to manufacturer's instructions.
7. Have students remove and replace power steering cylinder.
8. Have students refill reservoir with fluid.
9. Have students purge system.

PERFORMANCE OBJECTIVE 33

CRITERION-REFERENCED MEASURE

Questions

1. On what type steering system is the power steering cylinder found?
2. Purging the system means _____
3. What could power steering fluid leaking on hot pipes cause?

Answers

1. linkage type
2. to remove the air from the system.
3. flash fire

Practical Application

Have students to remove and replace power steering cylinder.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 33 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 33

REMOVING AND REPLACING POWER STEERING CYLINDER

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time and listed part(s) used.		
3. Raised vehicle.		
4. Raised hood.		
5. Removed hoses and drained fluid while observing safety rules regarding power steering fluid.		
6. Removed steering cylinder.		
7. Replaced with new or rebuilt cylinder as necessary.		
8. Reconnected hoses.		
9. Replaced fluid in reservoir.		
10. Purged system according to manufacturer's specifications.		
11. Checked for leaks.		
12. Test drove and returned vehicle to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 34

TASK

Remove and replace power steering control valve assembly.

STANDARD OF PERFORMANCE OF TASK

There can be no leaks; there can be no binding; and lubricants used must meet manufacturer's specifications.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Rack
Basic hand tool set
Line wrenches
Work order
Shop manual

ENABLING OBJECTIVES

1. Use basic hand tools.
2. Use line wrenches.
3. Use rack (lift), or similar jacking device.
4. Use shop manual.
5. Interpret work order.

RESOURCE

Motor's Auto Repair Manual, 1979, pp. 1-241.

TEACHING ACTIVITIES

1. Identify the type of steering system on which this unit is found.
2. Explain the procedures used in removing and replacing the power steering control valve assembly.
3. Demonstrate the procedure used in removing and replacing the power steering control valve.
4. Demonstrate the procedure used in adjusting the unit.
5. Demonstrate how to purge lines and check for leaks.
6. Have students remove and replace the power steering control valve assembly.
7. Have students adjust power steering control valve.
8. Have students purge line and check for leaks.

PERFORMANCE OBJECTIVE 34

CRITERION-REFERENCED MEASURE

Questions

1. On what type of system is the power steering control valve found?
2. Where is the adjusting nut found?
3. When is it necessary to purge a power steering system?

Answers

1. linkage type
2. under the adjusting cap
3. Anytime that the fluid is removed from the system and air can enter.

Practical Application

Have students remove and replace power steering control valve assembly.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 34 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 34

REMOVING AND REPLACING POWER STEERING CONTROL VALVE ASSEMBLY

Student's Name _____ **Date** _____

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time and listed all parts used.		
3. Raised and supported vehicle.		
4. Removed power steering lines and observed safety precautions.		
5. Removed end cap adjusting nut.		
6. Removed housing attaching bolts and/or screws.		
7. Removed cylinder.		
8. Replaced cylinder.		
9. Attached housing bolts.		
10. Replaced adjusting nut and adjusted to manufacturer's specifications.		
11. Replaced adjusting cover.		
12. Replaced hoses.		
13. Installed fluid in reservoir.		
14. Purged lines according to manufacturer's specifications.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 34

REMOVING AND REPLACING POWER STEERING CONTROL VALVE ASSEMBLY

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
15. Rechecked fluid level.		
16. Checked for leaks.		
17. Lowered vehicle and returned to service.		

APPROVED: YES _____ NO _____

_____

Evaluator's Signature **Date**

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 35

TASK

Remove and replace power steering pump.

STANDARD OF PERFORMANCE OF TASK

There can be no leaks; when pressure tested, power steering pump must meet manufacturer's specifications.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Hoist
Basic hand tool set
Pry bar
Line wrenches
Pump
Work order
Shop manual

ENABLING OBJECTIVES

1. Use basic hand tools.
2. Use line wrenches.
3. Use rack, hoist, lift, or other similar jacking device.
4. Use pry bar.
5. Use shop manual.
6. Interpret work order.

RESOURCES

1. **1985 Chrysler Corporation Service Manual,** Engine/Chassis/Body, p. 19-24.
2. Toboldt, Johnson and Olive. **Automotive Encyclopedia,** pp. 585-86.
3. Duffy. **Modern Automotive Mechanics,** p. 882.
4. deKryger, Kobacik and Bono. **Auto Mechanics: Theory and Service,** pp. 661, 670-72.
5. Stockel and Stockel. **Auto Mechanics Fundamentals,** pp.425-26.
6. Stockel and Stockel. **Auto Service and Repair,** pp. 773-77.

PERFORMANCE OBJECTIVE 35

TEACHING ACTIVITIES

1. Identify power steering pump.
2. Explain procedures in removing and replacing the power steering pump.
3. Demonstrate the procedures in removing and replacing the power steering pump.
4. Discuss the dangers of allowing fluid to spill onto hot pipes.
5. Discuss the dangers to skin if subjected to fluid for long periods of time.
6. Demonstrate the procedure used in purging the system.
7. Discuss the importance of proper belt tension.
8. Have students remove and replace power steering pump.
9. Have students adjust belt to proper tension according to manufacturer's specifications.
10. Have students purge the system.

CRITERION-REFERENCED MEASURE

Questions

1. Why is it necessary to avoid prying against the pump cover when adjusting belt tension?
2. What drives the power steering pump?
3. Why is it necessary to purge the power steering system of air?

Answers

1. Prying may cause leaks in the pump.
2. a belt driven by engine power
3. to remove the air from the system

Practical Application

Have students remove and replace power steering pump.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 35 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 35

REMOVING AND REPLACING POWER STEERING PUMP

Student's Name _____ **Date** _____

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time and listed parts used.		
3. Raised hood.		
4. Used rag to prevent fluid from leaking from fitting, and observed safety precautions.		
5. Placed hoses away from painted surfaces.		
6. Removed belt adjustment bolts and removed belt.		
7. Removed mounting bolts and nuts.		
8. Removed pump.		
9. Replaced pump.		
10. Installed mounting bolts.		
11. Replaced steering belt and adjusted according to manufacturer's specifications.		
12. Connected hoses.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 35

REMOVING AND REPLACING POWER STEERING PUMP

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
13. Filled with fluid and purged system according to manufacturer's specifications.		
14. Checked for leaks.		
15. Closed hood and returned vehicle to service.		

APPROVED: YES _____ NO _____

_____

Evaluator's Signature Date

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 36

TASK

Rebuild power steering pump.

STANDARD OF PERFORMANCE OF TASK

All gaskets and seals must be installed according to manufacturer's specifications; where pressure tested, pump must meet manufacturer's specifications.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Snap ring pliers
Basic hand tool set
Replacement parts
Shop manual
Work order

ENABLING OBJECTIVES

1. Use basic hand tools.
2. Use snap ring pliers.
3. Use shop manual.
4. Interpret work order.

RESOURCES

1. **1979 Oldsmobile Chassis Service Manual,** pp. 383-84.
2. Toboldt, Johnson and Olive. **Automotive Encyclopedia,** pp. 585-86.
3. Duffy. **Modern Automotive Mechanics,** p. 882.
4. deKryger, Kobacik and Bono. **Auto Mechanics: Theory and Service,** pp. 661, 670-72.
5. Stockel and Stockel. **Auto Mechanics Fundamentals,** pp.425-26.
6. Stockel and Stockel. **Auto Service and Repair,** pp. 773-77.

TEACHING ACTIVITIES

1. Identify power steering pump type.
2. Explain procedures in rebuilding power steering pump.
3. Demonstrate the procedures in rebuilding the power steering pump.
4. Explain why it is necessary to place new parts and seals in fluid for a few minutes.
5. Discuss O-ring location and the ease with which O-rings can be damaged.
6. Have students rebuild a power steering pump.

PERFORMANCE OBJECTIVE 36

CRITERION-REFERENCED MEASURE

Questions

1. Why is it necessary to be very clean with power steering pump parts?
2. What is one reason for placing new parts and seals in fluid?
3. Why are snap ring pliers used?

Answers

1. They are easily damaged by foreign matter.
2. Putting them in fluid aids in installation.
3. These pliers are used to remove retaining rings (snap rings).

Practical Application

Have students rebuild power steering pump.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 36 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 36

REBUILDING POWER STEERING PUMP

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time and listed parts used.		
3. Drained fluid from pump.		
4. Placed pump on clean cloth on bench.		
5. Removed pulley.		
6. Removed reservoir and observed O-ring location.		
7. Removed retaining pins.		
8. Removed cap.		
9. Turned cap towards bench and lightly tapped shaft end to remove pump gears.		
10. Removed control valve.		
11. Cleaned all parts and replaced as necessary.		
12. Placed parts and new seals in fluid for a few minutes and reassembled in reverse order.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 37

TASK

Remove and replace rack and pinion power steering assembly.

STANDARD OF PERFORMANCE OF TASK

There can be no leaks; there can be no binding of parts; and all connectors must be torqued to manufacturer's specifications.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Basic hand tool set
Hoist
Snap ring pliers
Replacement parts
Tie rod remover
Work order
Shop manual

ENABLING OBJECTIVES

1. Use basic hand tools.
2. Use tie rod removers.
3. Use shop manuals.
4. Use hoist on similar jacking device.
5. Interpret work orders.
6. Use tie rod remover.
7. Use snap ring pliers.

RESOURCES

1. **1985 Chrysler Corporation Service Manual** Engine/Chassis/Body, p. 19-24.
2. **1984 Chrysler Corporation Service Manual,** Front Wheel Drive/Chassis/Body, p. 19-12.
3. Duffy. **Modern Automotive Mechanics,** pp. 855-57,863, 867-70.
4. **Mitchell Automechanics,** p. 549.
5. Toboldt, Johnson and Olive. **Automotive Encyclopedia,** p. 578.

PERFORMANCE OBJECTIVE 37

TEACHING ACTIVITIES

1. Identify rack and pinion steering system.
2. Identify steering disconnect points, especially the column flange area.
3. Discuss the importance of using line wrenches to remove and replace lines from unit.
4. Demonstrate the procedure used in removing and replacing the power rack and pinion unit.
5. Demonstrate how to refill the system and purge according to manufacturing specifications.
6. Demonstrate the proper way to center steering wheel.
7. Have students remove and replace rack and pinion steering assembly.
8. Have students refill unit with fluid and purge.
9. Have students set toe-in and center steering wheel.
10. Have students check for leaks and binding of parts.

CRITERION-REFERENCED MEASURE

Questions

1. What tool is used to separate the tie rod ends?
2. Why is it necessary to check for binding of parts after a rack and pinion installation?
3. Why is it necessary to torque attaching bolts of a rack and pinion steering system?

Answers

1. The tie rod remover is used.
2. This could lead to occupant injury due to improper steering.
3. It avoids the possibility of improperly tightened bolts.

Practical Application

Have students remove and replace rack and pinion power steering assembly.

Method of Evaluating Practical Application

Use Checklist For performance Objective 37 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 37

REMOVING AND REPLACING RACK AND PINION POWER STEERING ASSEMBLY

Student's Name _____ **Date** _____

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time and listed parts used.		
3. Placed vehicle on rack.		
4. Where necessary, disconnected steering column flange from rack and pinion steering unit.		
5. Raised vehicle.		
6. Disconnected pressure and return lines from vehicle.		
7. Disconnected tie rods.		
8. Disconnected rack unit.		
9. Removed tie rods and reinstalled on new unit.		
10. Reinstalled new rack unit.		
11. Reconnected hoses.		
12. Lowered vehicle.		
13. Replaced steering flange; checked steering wheel for center.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 37

REMOVING AND REPLACING RACK AND PINION POWER STEERING ASSEMBLY

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
14. Added new fluid and purged system.		
15. Checked for leaks.		
16. Closed hood and test drove.		

APPROVED: YES _____ NO _____

Evaluator's Signature Date

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 38

TASK

Remove and replace rack and pinon manual steering assembly.

STANDARD OF PERFORMANCE OF TASK

There can be no leaks; there can be no binding; and all connectors must be torqued to manufacturer's specifications.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Basic hand tool set
Shop manual
Snap ring pliers
Work order
Tie rod remover
Replacement parts

ENABLING OBJECTIVES

1. Use basic hand tools.
2. Use tie rod remover.
3. Use snap ring pliers.
4. Use shop manuals.
5. Interpret work orders.

RESOURCES

1. **1985 Chrysler Corporation Service Manual**, Engine/Chassis/Body, p. 19-24.
2. **1984 Chrysler Corporation Service Manual**, Front Wheel Drive/Chassis/Body, p. 12-19.
3. Duffy. **Modern Automotive Mechanics,** pp. 855-57,863, 867-70.
4. **Mitchell Automechanics,** p. 549.
5. Toboldt, Johnson and Olive. **Automotive Encyclopedia,** p. 578.

TEACHING ACTIVITIES

1. Identify rack and pinion steering system.
2. Identify steering disconnect points, especially the column flange area.
3. Demonstrate the procedure used in removing and replacing the rack and pinon steering unit.
4. Demonstrate the proper way to center steering wheel if necessary.
5. Have students remove and replace rack and pinion steering unit.
6. Have students set toe-in and center steering wheel.
7. Have students check for binding linkage.

PERFORMANCE OBJECTIVE 38

CRITERION-REFERENCED MEASURE

Questions

1. Which tool is used to separate tie rods?
2. Why is it necessary to check for binding of parts after rack and pinion installations?
3. Why is it necessary to torque attaching bolts of a rack and pinion steering system?

Answers

1. The tie rod remover is used.
2. This could lead to occupant injury due to inability to steer.
3. It avoids the possibility of improperly tightened bolts.

Practical Application

Have students remove and replace rack and pinion manual steering assembly.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 38 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 38

REMOVING AND REPLACING RACK AND PINION MANUAL STEERING ASSEMBLY

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time and listed parts used.		
3. Placed vehicle on rack.		
4. When necessary, disconnected steering column flange from rack and pinion steering units.		
5. Raised vehicle.		
6. Disconnected tie rods.		
7. Disconnected rack unit.		
8. Removed tie rods from rack unit, checked bushing in rack and installed the steering assembly.		
9. Installed new rack.		
10. Lowered vehicle.		
11. Replaced steering flange.		
12. Added new fluid.		
13. Checked for leaks.		
14. Closed hood, test drove.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 39

TASK

Align front end.

STANDARD OF PERFORMANCE OF TASK

All manufacturer's specifications must be met; when road tested, there can be no vibration or pull.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Front end alignment machine
Shop manual
Basic hand tool set
Work order
Penetrating fluid

ENABLING OBJECTIVES

1. Use front end alignment machine.
2. Use basic hand tools.
3. Use shop manuals.
4. Interpret work order.

RESOURCES

1. deKryger, Kobacik and Bono. **Auto Mechanics: Theory and Service,** pp. 209, 673-74.
2. Toboldt, Johnson and Olive. **Automotive Encyclopedia,** pp. 619-21.

TEACHING ACTIVITIES

1. Demonstrate the proper procedure used when placing vehicle onto alignment machine.
2. Demonstrate the pre-check items such as tire pressure, body height, tire wear, etc.
3. Demonstrate how to check gear box adjustment.
4. Demonstrate how to check caster and camber.
5. Demonstrate how to adjust caster and camber.
6. Demonstrate how to adjust toe-in.
7. Have students align front end.

PERFORMANCE OBJECTIVE 39

CRITERION-REFERENCED MEASURE

Questions

1. Why is it necessary to check body height and equality?
2. Why is it necessary to check tire pressure before an alignment?
3. Why is it necessary to road test a vehicle after an alignment?

Answers

1. to insure there is no problem with the suspension which could hamper alignment
2. Low or high tire pressure could cause pull or wander, and rapid tire wear.
3. to insure a proper alignment and to be sure there is no pull or vibration

Practical Application

Have students align front end.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 39 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 39

ALIGNING FRONT END

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded start time and listed parts used.		
3. Placed vehicle on front end machine.		
4. Checked tire pressure, tire sizes and wear.		
5. Checked body height and equality.		
6. Centered steering wheel and locked to center.		
7. Checked gear box adjustment.		
8. Unlocked steering wheel and checked caster and camber.		
9. Adjusted caster and camber according to manufacturer's specifications.		
10. Set toe-in.		
11. Rechecked caster and camber.		
12. Road tested and returned to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 40

TASK

Adjust toe-in.

STANDARD OF PERFORMANCE OF TASK

Setting must meet manufacturer's specifications.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Front end alignment machine or toe bar
Work order
Shop manual
Basic hand tool set
Penetrating fluid

ENABLING OBJECTIVES

1. Use front end alignment machine.
2. Use basic hand tools.
3. Interpret work orders.
4. Use shop manuals.

RESOURCES

1. deKryger, Kobacik and Bono. **Auto Mechanics: Theory and Service,** pp. 210-11, 667, 674-76.
2. Stockel and Stockel. **Auto Mechanics Fundamentals,** pp. 408-09.
3. Stockel and Stockel. **Auto Service and Repair,** pp. 729-32.
4. Toboldt, Johnson and Olive. **Automotive Encyclopedia,** pp. 609-10, 618-19.

TEACHING ACTIVITIES

1. Describe toe-in.
2. Demonstrate how toe-in is checked.
3. Identify the adjustment sleeve or sleeves.
4. Demonstrate how to adjust toe-in.
5. Demonstrate how to adjust toe-in so as to center steering wheel.
6. Have students set toe-in.

PERFORMANCE OBJECTIVE 40

CRITERION-REFERENCED MEASURE

Questions

1. Why is it important to adjust toe-in last, after caster and camber?
2. What part changes the length of the tie rod?
3. Why is it necessary to have the wheels straight ahead when checking toe-in?

Answers

1. Caster and camber corrections affect toe-in settings.
2. adjustment sleeves
3. If the wheels are turned in either direction it could change the toe-in .

Practical Application

Have students adjust toe-in.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 40 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 40

ADJUSTING TOE-IN

Student's Name _____ **Date** _____

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time and listed parts used.		
3. Placed vehicle on level floor.		
4. Centered steering wheel.		
5. Measured vehicle across front of tires.		
6. Measured vehicle across rear of front tires.		
7. Used manufacturer's specifications, adjusted toe-in with correct sleeve,and centered steering wheel.		
8. Returned vehicle to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature _____ **Date** _____

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 41

TASK

Center steering wheel.

STANDARD OF PERFORMANCE OF TASK

Steering wheel crossbar(s) must remain straight while driving in a straight ahead position.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Basic hand tool set
Work order
Penetrating fluid
Shop manual

ENABLING OBJECTIVES

1. Use basic hand tools.
2. Interpret work order.
3. Use shop manual.

RESOURCES

1. Crouse and Anglin. **Automotive Mechanics**, 9th Edition, pp. 573-74.
2. Crouse. **Automotive Mechanics**, 8th Edition, pp. 555-56.

TEACHING ACTIVITIES

1. Explain what is meant by centering of steering wheel.
2. Demonstrate how to adjust left tie rod sleeve to obtain center.
3. Emphasize the importance of checking toe-in after this procedure.
4. Have students center steering wheel.
5. Have students check and adjust toe-in if necessary.

PERFORMANCE OBJECTIVE 41

CRITERION-REFERENCED MEASURE

Questions

1. Why is it necessary to have wheels straight ahead when checking toe-in?
2. Which tie rod is used to obtain steering center line?
3. Which part changes the length of the steering tie rod?

Answers

1. If the wheels are turned in either direction, it will affect toe-in readings.
2. the left
3. adjusting sleeve

Practical Application

Have students center steering wheel.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 41 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 41

CENTERING STEERING WHEEL

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded start time and listed parts used.		
3. Placed vehicle on level floor.		
4. Set steering wheel at center, adjusted left tie rod sleeve to obtain center line.		
5. Measured toe-in and adjusted according to manufacturer's specifications at correct tie rod end.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 42

TASK

Align rear wheels.

STANDARD OF PERFORMANCE OF TASK

Vehicle must track straight and true.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Alignment machine with rear wheel alignment capability
Basic hand tool set
Penetrating fluid
Frame aligning machine equipped with porto-power
Shop manual
Work order

ENABLING OBJECTIVES

1. Use alignment machine with rear wheel alignment capability.
2. Use basic hand tools.
3. Use frame aligning machine equipped with parts-power.
4. Use shop manuals.
5. Interpret work orders.

RESOURCES

1. de Kryger, Kobacik and Bono. **Auto Mechanics: Theory and Service**, p. 677.
2. Crouse and Anglin. **Automotive Mechanics,** 9th Edition, p 573.

TEACHING ACTIVITIES

1. Explain the purpose of rear wheel alignment and why it is necessary.
2. Discuss the importance of a correct front end alignment before aligning the rear wheels.
3. Demonstrate how to check and measure the rear wheel angles.
4. Demonstrate the various rear wheel adjustments and procedures.
5. Have students align front wheels according to manufacturer's specifications.
6. Have students align rear wheels.

PERFORMANCE OBJECTIVE 42

CRITERION-REFERENCED MEASURE

Questions

1. What is vehicle track?
2. How are the rear wheel angles adjusted?
3. Which end of the vehicle should be aligned first, the front or the rear?

Answers

1. An angle which allows the rear wheels of the vehicle to run in the same line with the front wheels.
2. by bending or shackle adjustment
3. front

Practical Application

Have students align rear wheels.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 42 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 42

ALIGNING REAR WHEELS

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded start time and listed parts used.		
3. Placed vehicle in level position.		
4. Aligned front end.		
5. Measured distance from center hub (front) to center axle (rear) and recorded readings.		
6. Adjusted according to manufacturer's specifications.		
7. Test drove and returned vehicle to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 43

TASK

Remove and replace steering wheel.

STANDARD OF PERFORMANCE OF TASK

Steering wheel must be centered on shaft; horn must work; and turn signal must cancel.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Hand tools
Shop manual
Puller
Work order

ENABLING OBJECTIVES

1. Use basic hand tools.
2. Use steering wheel puller.
3 Use shop manual.
4. Interpret work orders.

RESOURCES

1. **1974 Chevrolet Passenger Car Service and Overhaul Manual,** p. 9.
2. Duffy. **Modern Automotive Mechanics,** p. 873.
3. Stockel and Stockel. **Auto Service and Repair**, p. 773.

TEACHING ACTIVITIES

1. Relate instances where the steering wheel must be removed (i.e., to repair horn sounder ring, to repair turn signal switch, etc.)
2. Explain the necessity of disconnecting the battery.
3. Demonstrate how to mark the steering wheel and shaft for reassembly.
4. Demonstrate the procedure used in removing and replacing steering wheel from start to finish.
5. Have students remove and replace steering wheel.

PERFORMANCE OBJECTIVE 43

CRITERION-REFERENCED MEASURE

Questions

1. Why is it necessary to use a puller to remove the steering wheel?
2. Why is it necessary to mark the steering wheel and shaft before removing?
3. Give one example of why the steering wheel would have to be removed.

Answers

1. to avoid marring the shaft or steering wheel splines
2. to keep the steering gear in the correct position
3. replace turn signal switch, repair horn sounder ring, cruise control, headlights or wipers

Practical Application

Have students remove and replace steering wheel.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 43 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 43

REMOVING AND REPLACING STEERING WHEEL

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded start time and listed parts used.		
3.. Raised hood and disconnected battery terminal.		
4. Removed horn ring and horn connections.		
5. Removed shaft nut and washer and marked wheel to spline location.		
6. Used puller to remove steering wheel.		
7. Reversed procedure and installed steering wheel, noting position of marked spline.		
8. Lowered hood.		
9. Tested all systems.		
10. Returned vehicle to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 44

TASK

Remove and replace mast jacket assembly.

STANDARD OF PERFORMANCE OF TASK

All pads and wiring must be in working order; steering wheel must be centered; horn must work; and turn signal must cancel.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Clean fender cover
Work order
Basic hand tool set
Shop manual
Steering wheel puller
One-fourth inch socket set

ENABLING OBJECTIVES

1. Install fender cones.
2. Use basic hand tools.
3. Use steering wheel puller.
4. Interpret work order.
5. Use shop manual.

RESOURCE

1985 Chrysler Corporation Service Manual, Engine/Body/Chassis, p. 19-37.

TEACHING ACTIVITIES

1. Discuss various instances when mast jacket must be removed.
2. Explain the necessity of disconnecting the battery.
3. Demonstrate how to disconnect the wiring harness from the mast assembly.
4. Demonstrate how to remove the shift linkage and steering joint junction.
5. Identify and remove attaching bolts.
6. Demonstrate procedure for reinstalling the mast assembly.
7. Have students remove and replace the mast jacket assembly.

PERFORMANCE OBJECTIVE 44

CRITERION-REFERENCED MEASURE

Questions

1. The mast jacket must be removed in order to replace a shift tube. Yes or No
2. Why is it necessary to remove the battery cable before removing the mast assembly?
3. Which component is housed in the mast assembly?

Answers

1. Yes
2. to avoid damaging wiring
3. turn signal switch and wiring

Practical Application

Have students remove and replace mast jacket assembly.

Method of Evaluating Practical Application

Use checklist For Performance Objective 44 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 44

REMOVING AND REPLACING MAST JACKET ASSEMBLY

Student's Name _____ **Date** _____

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score for 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time and listed parts used.		
3. Raised hood and disconnected battery terminal.		
4. Placed cloth on front seat.		
5. Removed steering wheel nut, washer and wheel.		
6. Removed turn signal wiring at harness connection under dash.		
7. Removed ignition switch wiring.		
8. Removed gear shift linkage at mast jacket.		
9. Removed attaching bolts at float junction of steering shaft.		
10. Removed floor attaching bolts and strap.		
11. Removed mounting bolts from mast jacket to dash.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 44

REMOVING AND REPLACING MAST JACKET ASSEMBLY

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
12. Removed assembly from vehicle and made repairs.		
13. Reversed procedures for installation.		
14. Checked all systems and returned vehicle to service.		

APPROVED: YES _____ NO _____

_____

Evaluator's Signature **Date**

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 45

TASK

Remove and replace tilt wheel and telescopic.

STANDARD OF PERFORMANCE OF TASK

Steering wheel must be in central position.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Basic hand tool set
Work order
Clean fender cover
Shop manual
Puller
Steering wheel

ENABLING OBJECTIVES

1. Use basic hand tool set.
2. Use pullers.
3. Interpret work orders.
4. Use shop manuals.

RESOURCES

1. **1976 Chevrolet Passenger Car Service Manual,** p. 9-4.
2. **Mitchell Automechanics,** p. 556.
3. deKryger, Kobacik and Bono. **Auto Mechanics: Theory and Service,** pp. 665-66.

TEACHING ACTIVITIES

1. Discuss instances when the steering wheel must be removed.
2. Explain why it is important to remove battery cable before removing steering wheel.
3. Discuss the importance of marking the wheel and spline location.
4. Demonstrate the procedure for removing and replacing tilt steering wheel and telescopic.
5. Have students remove and replace steering wheel and telescopic.

PERFORMANCE OBJECTIVE 45

CRITERION-REFERENCED MEASURE

Questions

1. What should you mark before the wheel is removed?
2. Which battery cable is removed before disassembly?
3. When should the battery be reconnected?

Answers

1. steering wheel to shaft location
2. negative
3. after completing the task

Practical Application

Have students remove and replace tilt wheel and telescopic.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 45 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 45

REMOVING AND REPLACING TILT WHEEL AND TELESCOPIC

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time and listed parts used.		
3. Raised hood and removed negative battery cable.		
4. Placed cloth on front seat.		
5. Pushed and turned locking lever counter clockwise until released.		
6. Removed attaching plate.		
7. Removed steering wheel nut.		
8. Removed steering wheel assembly.		
9. Replaced tilt wheel.		
10. Reinstalled steering nut and tightened to specifications.		
11. Reattached plate and closed hood.		
12. Road tested and returned vehicle to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 46

TASK

Remove and replace steering column.

STANDARD OF PERFORMANCE OF TASK

Replaced column must be rigid; all accessories must function properly; and there must be no binding.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Clean fender cover
Shop manual
Basic hand tool set
Work order
Steering wheel puller

ENABLING OBJECTIVES

1. Use basic hand tools.
2. Use pullers.
3. Interpret work orders.
4. Use shop manuals.

RESOURCES

1. **1985 Chrysler Corporation Service Manual,** Engine/Chassis/Body, p. 19-33.
2. Duffy. **Modern Automotive Mechanics,** p. 856.
3. Crouse and Anglin. **Automotive Mechanics,** pp. 451, 454.
4. **Mitchell Automechanics,** p. 554.
5. deKryger, Kobacik and Bono. **Auto Mechanics: Theory and Service,** p. 569.
6. Stockel and Stockel. **Auto Service and Repair,** p. 771.

TEACHING ACTIVITIES

1. Discuss instances when column must be removed.
2. Review the importance of following manufacturer's procedures so there will be no change to the column alignment.
3. Review the importance of checking all attaching equipment for proper operation.
4. Demonstrate the procedure used in removing and replacing the steering column.
5. Have students remove and replace the steering column.

PERFORMANCE OBJECTIVE 46

CRITERION-REFERENCED MEASURE

Questions

1. Why must a steering column be removed?
2. Why is it necessary to remove the battery cable before starting work on the steering column?
3. What causes the binding of column components?

Answers

1. to replace shift tube, repair wiring
2. to avoid electrical component damage
3. misaligned parts

Practical Application

Have students remove and replace steering column.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 46 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 46

REMOVING AND REPLACING STEERING COLUMN

Student's Name _____ **Date** _____

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time and listed part used.		
3. Placed cover on seat.		
4. Removed horn ring, raised hood and disconnected battery.		
5. Removed steering wheel nut.		
6. Used suitable puller in removing steering wheel.		
7. Removed directional signal switch.		
8. Disconnected mounting brackets.		
9. Disconnected steering shaft coupler.		
10. Removed steering column.		
11. Replaced steering column.		
12. Connected steering coupler.		
13. Connected mounting brackets.		
14. Replaced directional signals.		
15. Reinstalled steering wheel and torqued to specifications.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 46

REMOVING AND REPLACING STEERING COLUMN

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
16. Reinstalled horn ring.		
17. Checked attaching bolts and equipment for operation.		
18. Connected battery and removed seat cover.		
19. Road tested and returned vehicle to service.		

APPROVED: YES _____ NO ____

_____

Evaluator's Signature **Date**

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 47

TASK

Rebuild steering column.

STANDARD OF PERFORMANCE OF TASK

Replaced column must be rigid; all accessories must function properly; and there must be no binding.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Clean fender cover
Work order
Basic hand tool set
Shop manual
Steering wheel puller
Socket set 3/8 and 1/4 inch

ENABLING OBJECTIVES

1. Use basic hand tools.
2. Use pullers.
3. Interpret work orders.
4. Use shop manuals.

RESOURCES

1. **1985 Chrysler Corporation Service Manual**, Engine/Chassis/Body, p. 19-37.
2. Duffy. **Modern Automotive Mechanics,** p. 856.
3. Crouse and Anglin. **Automotive Mechanics,**.pp. 451, 454.
4. **Mitchell Automechanics,** p. 554.
5. deKryger, Kobacik and Bono. **Auto Mechanics: Theory and Service,** p. 569.
6. Stockel and Stockel. **Auto Service and Repair,** p. 771.

TEACHING ACTIVITIES

1. Have students give examples of why it is necessary to rebuild a steering column.
2. Discuss the importance of checking all parts for wear and operation.
3. Review the importance of following manufacturer's procedures in the rebuilding process.
4. Discuss the importance of checking collapsible shaft parts for proper operation.

PERFORMANCE OBJECTIVE 47

TEACHING ACTIVITIES (contd.)

5. Demonstrate how to rebuild a steering column.
6. Have students rebuild a steering column.

CRITERION-REFERENCED MEASURE

Questions

1. Why should a steering column be rigidly mounted?
2. Why would it be necessary to rebuild a steering column?
3. Why should collapsible steering shafts always be checked in a rebuild?

Answers

1. to insure driver safety and avoid binding
2. to replace a shift tube
3. to be sure they work properly in case of an accident.

Practical Application

Have students rebuild steering column.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 47 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 47

REBUILDING STEERING COLUMN

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the task within a reasonable time. A score for 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded start time and listed parts used.		
3. Replaced steering column on work bench cloth.		
4. Removed steering wheel lock plate and clip.		
5. Removed turn signal screw levers and switch.		
6. Removed shift housing screws and housing.		
7. Detached upper and lower brackets.		
8. Lowered shift tube from bottom.		
9. Checked column for bent condition.		
10. Reassembled.		
11. Road tested and returned vehicle to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 48

TASK

Remove and replace steering column bearings, shift tube and socket.

STANDARD OF PERFORMANCE OF TASK

When steering wheel is turned sharply left or right, released steering wheel must return to central position; there must be no binding.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Clean fender cover
Work order
Basic hand tool set
Shop manual
Steering wheel puller

ENABLING OBJECTIVES

1. Use basic hand tools.
2. Use pullers.
3. Interpret work orders.
4. Use shop manuals.

RESOURCE

1985 Chrysler Corporation Service Manual, Engine/Chassis/Body, p. 19-40.

TEACHING ACTIVITIES

1. Explain the procedure used in checking steering column bearings and shift tube condition, before disassembly.
2. Cite instances where there has been bearing failure, and its causes.
3. Review the importance of following manufacturer's procedures.
4. Discuss the importance of proper alignment of all bearings and shift tube components.
5. Demonstrate how to remove and replace steering column bearings, shift tube and socket.
6. Have students remove and replace steering column bearings, shift tube and socket.

PERFORMANCE OBJECTIVE 48

CRITERION-REFERENCED MEASURE

Questions

1. What purpose do the steering column bearings serve?
2. What is the function of the shift tube?
3. What part of the shift tube is likely to have wear?

Answers

1. to support the steering shaft
2. connects the gear shift with the transmission linkage
3. the upper part near the gear shifter

Practical Application

Have students remove and replace steering column bearings, shift tube and socket.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 48 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 48

REMOVING AND REPLACING STEERING COLUMN BEARINGS, SHIFT TUBE AND SOCKET

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. a score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded start time and listed parts used.		
3. Covered seat with cloth.		
4. Raised hood and disconnected battery.		
5. Removed turn signal screws and levers.		
6. Removed shift housing screws and housing.		
7. Detached upper and lower brackets.		
8. Lowered shift tube from bottom.		
9. Checked column for bent condition.		
10. Reassembled.		
11. Road tested and returned vehicle to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 49

TASK

Remove and replace turn signal switch.

STANDARD OF PERFORMANCE OF TASK

Turn signal switch must energize correct lights when moved and must cancel when steering wheel turned to straight ahead position.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Basic hand tool set
Work order
Clean fender cover
Shop manual
Puller

ENABLING OBJECTIVES

1. Use basic hand tools.
2. Use pullers.
3. Interpret work orders.
4. Use shop manuals.

RESOURCES

1. **1985 Chrysler Corporation Service Manual**, Engine/Chassis/Body, p. 19-42.
2. deKryger, Kobacik and Bono. **Auto Mechanics: Theory and Service,** pp. 384, 389, 731.
3. **Mitchell Automechanics,** pp.523-24.

TEACHING ACTIVITIES

1. Have the students identify the part(s) to be removed and replaced.
2. Explain the procedures used in removing and replacing the turn signal switch.
3. Explain how signals cancel and show students the parts responsible.
4. Discuss the ease with which the parts are broken.
5. Explain how horn is operated, show parts involved in operation.
6. Demonstrate turn signal switch removal and replacement.
7. Have student remove and replace turn signal switch.

PERFORMANCE OBJECTIVE 49

CRITERION-REFERENCED MEASURE

Questions

1. Where is the turn signal switch usually located?
2. When should the turn signal cancel?
3. Is it necessary to remove battery cable when servicing a turn signal switch? Yes or No

Answers

1. under the steering wheel, in the column assembly
2. when the steering wheel is returned to the straight-ahead position
3. Yes

Practical Application

Have students remove and replace turn signal.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 49 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 49

REMOVING AND REPLACING TURN SIGNAL SWITCH

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded start time and listed parts used.		
3. Raised hood and disconnected battery.		
4. Covered seat.		
5. Removed horn button.		
6. Used suitable puller to remove steering wheel.		
7. Removed lever from turn signal switch.		
8. Removed turn signal switch.		
9. Reversed procedure and installed switch.		
10. Checked work and returned vehicle to service.		

APPROVED: YES ____ NO ____

Evaluator's Signature **Date**

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 50

TASK

Remove and replace ignition switch rack.

STANDARD OF PERFORMANCE OF TASK

Starter must turn when ignition switch is turned on.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Nut driver set
Pliers

ENABLING OBJECTIVES

1. Use nut drive set or $\frac{1}{4}$ socket set.
2. Use pliers.
3. Use manuals.
4. Interpret work orders.

RESOURCE

1979 Oldsmobile Chassis Service Manual, Section 3B, p. 4-24.

TEACHING ACTIVITIES

1. Identify part to be removed and replaced.
2. Demonstrate how ignition switch rack works, also demonstrate accessory, run, and start positions.
3. Explain steps used in removing and replacing switch rack.
4. Demonstrate the removal and replacement of ignition switch rack.
5. Have students remove and replace ignition switch rack.

PERFORMANCE OBJECTIVE 50

CRITERION-REFERENCED MEASURE

Questions

1. What is the function of the ignition switch rack?
2. When the ignition key is turned to the start position and the starter does not turn, it may be necessary to _____ .
3. Where is the ignition switch usually located?

Answers

1. It activates the ignition switch.
2. adjust the ignition rack or ignition switch
3. in the lower part of the mast jacket

Practical Application

Have students remove and replace ignition switch rack.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 50 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 50

REMOVING AND REPLACING IGNITION SWITCH RACK

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order, recorded start time, and listed parts used.		
2. Disconnected battery terminal.		
3. Located ignition switch.		
4. Removed attaching screws.		
5. Released clips to activating rod.		
6. Removed ignition switch rack.		
7. Replaced rack in reverse order.		
8. Reconnected battery.		
9. Adjusted if necessary.		
10. Checked work and returned vehicle to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 51

TASK

Remove and replace emergency flasher switch.

STANDARD OF PERFORMANCE OF TASK

All four flashers must turn on and off.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Basic hand tool set
Steering wheel puller
Work order

ENABLING OBJECTIVES

1. Use basic hand tool set.
2. Use pullers.
3. Interpret work orders.

RESOURCE

1985 Chrysler Corporation Service Manual, Engine/Chassis/Body, Section 19, pp. 44-45.

TEACHING ACTIVITIES

1. Identify part to be removed and replaced.
2. Identify points of failure. (wires, plastic, etc.)
3. Discuss the importance of removing the battery cable.
4. Describe the procedure used in removing and replacing the emergency flasher switch.
5. Demonstrate the removal and replacement of the emergency flasher switch.
6. Have students remove and replace the emergency flasher switch.

PERFORMANCE OBJECTIVE 51

CRITERION-REFERENCED MEASURE

Questions

1. Is it necessary to remove the battery cable before working on the emergency flasher switch? Yes or No
2. When removing the emergency flasher switch, is it also necessary to remove the turn signal switch? Yes or No
3. Is it necessary to remove the steering wheel to replace emergency flasher switch? Yes or No

Answers

1. Yes, the negative cable.
2. Yes, if it has a column mounted switch.
3. Yes, if the emergency flasher is made into a single unit.

Practical Application

Have students remove and replace emergency flasher switch.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 51 to determine if the assignment was completed for competency.

PERFORMANCE OBJECTIVE 51

CRITERION-REFERENCED MEASURE

Questions

1. Is it necessary to remove the battery cable before working on the emergency flasher switch? Yes or No
2. When removing the emergency flasher switch, is it also necessary to remove the turn signal switch? Yes or No
3. Is it necessary to remove the steering wheel to replace emergency flasher switch? Yes or No

Answers

1. Yes, the negative cable.
2. Yes, if it has a column mounted switch.
3. Yes, if the emergency flasher is made into a single unit.

Practical Application

Have students remove and replace emergency flasher switch.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 51 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 51

REMOVING AND REPLACING EMERGENCY FLASHER SWITCH

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order, recorded start time, and listed parts used.		
2. Obtained vehicle and removed battery terminal.		
3. Removed screws holding horn ring.		
4. Removed steering wheel nut.		
5. Used steering wheel puller, and removed steering wheel.		
6. Removed turn signal and flasher switch assembly screws and lever.		
7. Removed wiring at lower wiring harness connection.		
8. Replaced switch in reverse order.		
9. Replaced battery cables and checked operation of switch and signals.		
10. Returned vehicle to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING STEERING SYSTEM.

PERFORMANCE OBJECTIVE 52

TASK

Replace shift detent in column.

STANDARD OF PERFORMANCE OF TASK

Shift lever must return with detent.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Small ball peen hammer
Punch set
Needle nose pliers
Work order

ENABLING OBJECTIVES

1. Use ball peen hammer.
2. Use punch set.
3. Use needle nose pliers.
4. Use magnet.
5. Interpret work orders.

RESOURCES

1. **1979 Oldsmobile Chassis Service Manual**, Section 3B, pp. 4 - 22.
2. **Mitchell Automechanics**, pp. 456-57.
3. deKryger, Kobacik and Bono. **Auto Mechanics: Theory and Service**, p. 527.

TEACHING ACTIVITIES

1. Identify part to be replaced.
2. Describe the function of the shift detent and demonstrate its use.
3. Describe the procedure used in removing and replacing the detent.
4. Demonstrate the removal and replacement of the shift detent.
5. Have students remove and replace detent in column.

PERFORMANCE OBJECTIVE 52

CRITERION-REFERENCED MEASURE

Questions

1. Where is the shift detent located?
2. What is used in removing the drift pin?
3. The detent serves what purpose in the shift assembly?

Answers

1. in the steering columns at the end of the shift lever
2. punch and hammer
3. The detent gives the transmission a positive lock feel to the driver and aids in transmission gear changes.

Practical Application

Have students remove and replace shift detent in column.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 52 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 52

REPLACING SHIFT DETENT IN COLUMN

Student's Name _____ **Date** _____

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order and recorded start time.		
2. Removed battery cable.		
3. Located drift pin in shift lever.		
4. Used proper punch to drive pin from lever.		
5. Removed shift lever.		
6. Removed detent spring and seat.		
7. Replaced detent spring and seat.		
8. Replaced lever and drive pin.		
9. Replaced battery cable.		
10. Checked operating lever and returned vehicle to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature _____ **Date** _____

DUTY MAINTAINING STEERING SYSTEM

PERFORMANCE OBJECTIVE 53

TASK

Remove and replace power steering seals (steering box).

STANDARD OF PERFORMANCE OF TASK

Steering gear box must be free of all fluids.
Seals must not leak.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Basic hand tool set
Pitman arm puller
Seal installer
Snap ring pliers
Drain pan
Hoist
Work order

ENABLING OBJECTIVES

1. Identify and use basic hand tools.
2. Read and interpret a work order.
3. Use a hoist.

RESOURCES

1. **1975 Pontiac Service Manual,** Section 9, p. 52.
2. Stockel and Stockel. **Auto Mechanics Fundamentals,** p. 414.

TEACHING ACTIVITIES

1. Demonstrate the steps in removing and replacing power steering seals.
2. Explain the importance of cleaning and inspecting the housing and the pitman shaft before installing the new seal.
3. Have the students put one layer of tape around the splines on the pitman shaft to prevent the splines from cutting the new seal.
4. Review the importance of following manufacturer's notes and cautions.
5. Show how to properly service and inspect for leaks.
6. Have the students remove and replace a power steering seal.

PERFORMANCE OBJECTIVE 53

CRITERION-REFERENCED MEASURE

Questions

1. What do you look for when you inspect the housing and the pitman shaft seal area?
2. To prevent the new seal from being _____ one should always tape the pitman shaft _____.
3. It is very important to always follow manufacturer's notes and _____.

Answers

1. burrs, roughness and/or pitting
2. cut, splines
3. cautions

Practical Application

Have the students remove and replace power steering seals.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 53 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 53 EVALUATION

REMOVING AND REPLACING POWER STEERING SEALS

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the task within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Must list all parts used.		
3. Raised and supported vehicle.		
4. Using pitman arm puller, removed arm. NOTE: Be sure to place drain pan under pitman shaft.		
5. Removed seal snap ring and washer.		
6. Using self-tapping screws, put one screw in each side of seal face. CAUTION: Do not touch shaft or seal housing with screws.		
7. Using pliers, removed seals.		
8. Replaced seals.		
9. Reversed items 3-5.		
10. Refilled steering reservoir.		
11. Checked vehicle and returned to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

MAINTAINING BRAKE SYSTEM

DUTY MAINTAINING BRAKE SYSTEM

PERFORMANCE OBJECTIVE 54

TASK

Check brake operation.

STANDARD OF PERFORMANCE OF TASK

Brakes must stop vehicle without pulling to either side.
Brakes must not lock under any conditions.
All out of tolerance lining pads, rotors and drums must be identified.
All leaky cylinders must be identified.

SOURCE OF STANDARDS

Writing Team of Incumbent Workers.

CONDITIONS FOR PERFORMANCE OF TASK

Rack
Basic hand tool set
Air
Penetrating fluid
Rubber mallet
Hammer

ENABLING OBJECTIVES

1. Identify and use basic hand tools.
2. Read and interpret a work order.
3. Use a hoist.

RESOURCES

1. Stockel and Stockel. **Auto Service and Repair,** pp. 678-18.
2. Toboldt, Johnson and Olive. **Automotive Encyclopedia,** pp. 515-52.

TEACHING ACTIVITIES

1. Discuss the health hazards associated with asbestos found in many brake shoe materials.
2. Explain the difference between a possible grease seal leak and wheel cylinder brake fluid leaks.
3. Have the students develop a checklist for a thorough and complete inspection.
4. Show the students how to check the wheel cylinder for leakage by pulling back the lip of the dust cover and looking for fluid. NOTE: Any wetness in this area signals trouble in the cylinder.

PERFORMANCE OBJECTIVE 54

TEACHING ACTIVITIES (Continued)

5. Explain why you should never apply braking pressure when a brake drum or disc caliper is removed.
6. Review why it is important to always follow the manufacturer's specifications for each individual vehicle when available.

CRITERION-REFERENCED MEASURE

Questions

1. What will cause the vehicle to pull to either side when the brakes are applied?
2. Following an inspection checklist makes for a _____ and _____ inspection.
3. How much leakage is allowed at the wheel cylinder before repair is required?
4. Disc brake pads should be changed when worn to within _____ of the pad base.

Answers

1. pads are contaminated with grease or brake fluid
2. thorough, complete
3. no leakage allowed
4. one-eighth inch

Practical Application

Have the students check brake operation.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 54 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 54

CHECKING BRAKE OPERATION

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the task within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order and test drove vehicle.		
2. Recorded starting time. NOTE: Listed all parts used.		
3. Checked master cylinder for fluid level. NOTE: Checked vacuum hoses on power brakes.		
4. Raised vehicle.		
5. Checked brake lines and hoses.		
6. Removed all wheels and drums. Inspected for leaking cylinders, leaking calipers and checked worn pads and lining for proper thickness.		
7. Repaired as necessary.		
8. Reversed procedure.		
9. Test drove and returned to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING BRAKE SYSTEM

PERFORMANCE OBJECTIVE 55

TASK

Inspect brake hose and lines.

STANDARD OF PERFORMANCE OF TASK

All damaged lines and hoses must be detected and noted.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Racks
Work order
Lights
Shop manual

ENABLING OBJECTIVES

1. Identify procedures for raising a vehicle on a lift.
2. Read and interpret a work order.
3. Differentiate between brake hoses and lines and other lines on the vehicle.

RESOURCE

Stockel and Stockel. **Auto Service and Repair**, pp. 678-18.

TEACHING ACTIVITIES

1. Lecture the students on the importance of brakes from a safety standpoint.
2. Discuss why the brake lines must be supported to prevent vibration.
3. Discuss the need for a flexible brake hose.
4. Discuss why brake lines must be in excellent condition, i.e., free of rust, dents, and kinks.
5. Have the students draw a typical brake schematic showing the hoses and lines.
6. Inspect a vehicle with the students pointing out the areas most susceptible to leakage, such as hose and line couplings and line to cylinder connections.

PERFORMANCE OBJECTIVE 55

CRITERION-REFERENCED MEASURE

Questions

1. How much fluid leakage is allowed at brake line coupling?
2. Brake lines must be supported to prevent _____.
3. Why is it so important to do a thorough brake line and hose inspection?

Answers

1. no leakage allowed
2. vibration
3. because of the safety involved and to prevent possible brake failure

Practical Application

Have the students inspect brake hose and lines.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 55 to determine if the assignment was completed for competency.

PERFORMANCE OBJECTIVE 55

CRITERION-REFERENCED MEASURE

Questions

1. How much fluid leakage is allowed at brake line coupling?
2. Brake lines must be supported to prevent _____.
3. Why is it so important to do a thorough brake line and hose inspection?

Answers

1. no leakage allowed
2. vibration
3. because of the safety involved and to prevent possible brake failure

Practical Application

Have the students inspect brake hose and lines.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 55 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 55

INSPECTING BRAKE HOSE AND LINES

Student's Name _____ Date _____

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Raised and supported vehicle on four corners.		
3. Inspected all brake lines for leaks, abnormal rust or damage.		
4. Lowered vehicle and raised hood.		
5. Checked line to master cylinder.		
6. Lowered hood, noted findings on work order and returned vehicle to service.		

APPROVED: YES ____ NO ____

Evaluator's Signature _____ Date _____

DUTY MAINTAINING BRAKE SYSTEM

PERFORMANCE OBJECTIVE 56

TASK

Remove and replace brake hose.

STANDARD OF PERFORMANCE OF TASK

Replaced brake hose must meet manufacturer's specifications and must not leak.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Rack
Basic hand tool set
Penetrating sealer
Line wrenches
Hammer
Rubber mallet
Impact wrench
Brake hose
Hoist
Work order

ENABLING OBJECTIVES

1. Identify and use basic hand tools.
2. Identify procedures for raising a vehicle on hoist safely.
3. Read and interpret a work order.
4. Identify and use line wrenches.

RESOURCE

Stockel and Stockel. **Auto Service and Repair,** pp. 79-95 and 678-718.

TEACHING ACTIVITIES

1. Have students review chapter in text, **Auto Service and Repair,** pp. 79-85, 678-718, which covers tubing and hoses.
2. Demonstrate how the tubing nut must be turned while holding the hose end nut.
3. Discuss the necessity of selecting the replacement hose of proper length and quality.
4. Demonstrate how the swivel or line of the hose must be tightened last while supporting the hose nut to prevent twisting the hose.
5. Conduct students in proper method of bleeding the brake system .
6. Have the students, after the test drive, recheck the master cylinder and the replaced hoses for leaks.

PERFORMANCE OBJECTIVE 56

CRITERION-REFERENCED MEASURE

Questions

1. Why should you always start the fittings by hand?
2. Why must you always tighten the line of the brake hose last?
3. What should be checked for proper servicing before bleeding the brakes?

Answers

1. to prevent cross-threading
2. because the wheel end doesn't swivel
3. master cylinder reservoir

Practical Application

Have the students remove and replace brake hose.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 56 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 56

REMOVING AND REPLACING A BRAKE HOSE

Student's Name _____ **Date** _____

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Must list all parts used.		
3. Raised and supported side to be worked on.		
4. Removed line-hose clip. Using line wrenches, removed inner end of hose first.		
5. Removed wheel end of hose.		
6. Replaced hose.		
7. Replaced 'C' clip.		
8. Raised hood and checked fluid at master cylinder.		
9. Bled system.		
10. Rechecked fluid and brake operation.		
11. Closed hood, lowered vehicle and test drove.		
12. Checked for leaks.		
13. Returned vehicle to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature _____ **Date** _____

DUTY MAINTAINING BRAKE SYSTEM

PERFORMANCE OBJECTIVE 57

TASK

Remove and replace brake line.

STANDARD OF PERFORMANCE OF TASK

Replaced brake line must not leak or rub on body parts.

SOURCE OF STANDARD

Writing team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Rack
Impact wrench set
Penetrating fluid
Line wrenches
Hammer
Rubber mallet
Basic hand tool set
Work order

ENABLING OBJECTIVES

1. Identify and use basic hand tools.
2. Read and interpret a work order.
3. Identify and use line wrench.
4. Use hoist lift or other jacking device.

RESOURCE

Stockel and Stockel. **Auto Service and Repair,** pp. 79-85 and 678-718.

TEACHING ACTIVITIES

1. Have the students review, pp.79-85 and pp.678-718 in **Auto Service and Repair**.
2. Demonstrate the correct method of fastening a flared fitting.
3. Discuss the size and quality of replacement brake lines.
4. Have the students practice connecting a brake line.
5. Demonstrate the proper method of bleeding the brake system.
6. Have the students remove and replace a brake line.

PERFORMANCE OBJECTIVE 57

CRITERION-REFERENCED MEASURE

Questions

1. Why should you always start the fitting by hand?
2. Always check the _____ for proper servicing before bleeding the brakes.
3. What percentage of leakage is allowed on a replaced brake line?

Answers

1. to prevent cross-threading
2. master cylinder reservoir
3. no leakage allowed

Practical Application

Have the students remove and replace brake line.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 57 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 57

REMOVING AND REPLACING A BRAKE LINE

Student's Name _____ **Date** _____

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student,. Pay close attention to items to be evaluated. Be sure the student completes the task within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Listed all parts used.		
3. Raised and supported side wheel line that was to be replaced.		
4. Using line wrenches, removed both ends of line.		
5. Replaced line.		
6. Raised hood and checked master cylinder for fluid level.		
7. Filled and replaced cap.		
8. Bled system.		
9. Rechecked master cylinder fluid.		
10. Checked brake pedal height.		
11. Closed hood and lowered vehicle to floor and test drove.		
12. Checked for leaks.		
13. Returned vehicle to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature _____ **Date** _____

DUTY MAINTAINING BRAKE SYSTEM

PERFORMANCE OBJECTIVE 58

TASK

Adjust brake shoes.

STANDARD OF PERFORMANCE OF TASK

There can be no left or right pulling when brakes are applied; shoes must be close to drum with no drag.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Rack
Vehicle with drum type shoes
Screwdrivers
Brake spoon
Work order

ENABLING OBJECTIVES

1. Read and interpret a work order.
2. Identify procedures to raise and support a vehicle safely.
3. Differentiate between disc and drum brakes.

RESOURCE

Stockel and Stockel. **Auto Service and Repair,** pp. 678- 718.

TEACHING ACTIVITIES

1. Have the students read the chapter in the text, **Auto Service and Repair,** pp. 678-718.
2. Collect different types of brake adjusters and pass around to students while explaining how each adjuster works.
3. Have the students raise a vehicle and remove a wheel and drum.
4. Demonstrate to the students how a thin screwdriver or ice pick must be inserted to hold the self adjusting lever out of the way to permit the star wheel to be backed off.
5. Have the students replace the drum and wheel.
6. Have the students practice adjusting brakes so each wheel has the same amount of running clearance.

PERFORMANCE OBJECTIVE 58

CRITERION-REFERENCED MEASURE

Questions

1. What is the purpose of inserting a screw driver along side the brake spoon when backing off the star wheel?
2. The adjusting slot will either be located in the back plate or the _____.
3. Adjust the shoe to drum clearance until tight and then back off until wheel has _____ drag.

Answers

1. to hold self adjusting lever clear of star wheel
2. drum
3. slight

Practical Application

Have students adjust brake shoes.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 58 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 58

ADJUSTING BRAKE SHOES

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: List all parts used.		
3. Raised vehicle.		
4. Located adjusting slot in back plate or drum.		
5. Removed dust cover from adjusting slot.		
6. Using adjusting tool, adjusted until tight, backed off until wheel has slight drag.		
7. Lowered vehicle and road tested.		
8. Returned vehicle to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING BRAKE SYSTEM

PERFORMANCE OBJECTIVE 59

TASK

Free-up parking cable and linkage.

STANDARD OF PERFORMANCE OF TASK

Cables must not bind when parking brake is released.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Rack
Basic hand tool set
Penetrating fluid
Work order

ENABLING OBJECTIVES

1. Identify and use basic hand tools.
2. Read and interpret a work order.
3. Identify procedures to raise and support vehicle safely.

RESOURCES

1. Stockel and Stockel. **Auto Service and Repair**, pp. 678-718.
2. Webster. **Auto Mechanics**, pp. 470-72.

TEACHING ACTIVITIES

1. Have the students read the chapter in the text, **Auto Service and Repair**, pp. 678-718, which covers brakes.
2. Discuss the importance of parking brakes.
3. Explain the operation of parking brakes.
4. Explain the different types of parking brakes.
5. Have the students raise the vehicle on the lift and locate the parking brake components.
6. Demonstrate the proper way to lubricate the cables and linkage, (inside and underneath the vehicle).
7. Have the students practice freeing up a frozen or binding cable and linkage.

PERFORMANCE OBJECTIVE 59

CRITERION-REFERENCED MEASURE

Questions

1. What is the purpose of a parking brake?
2. What type of oil is used to free a stuck or frozen parking brake cable?
3. What could cause the cables to become frozen?

Answers

1. to hold the vehicle when parked and to stop the vehicle in an emergency
2. a penetrating type oil
3. road tar, moisture, abuse

Practical Application

Have the students free-up a parking brake cable and linkage.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 59 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 59

FREEING-UP A PARKING BRAKE CABLE AND LINKAGE

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Must list all parts used.		
3. Raised vehicle and support.		
4. Removed adjusting nuts.		
5. Using a penetrating type oil, lubricated linkage and cable.		
6. Operated until free.		
7. Readjusted.		
8. Lowered vehicle and checked operation of parking brake.		
9. Returned vehicle to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING BRAKE SYSTEM

PERFORMANCE OBJECTIVE 60

TASK

Adjust parking brake linkage.

STANDARD OF PERFORMANCE OF TASK

Parking brake must lock wheels when applied and release completely when released.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Rack
Penetrating fluid
Basic hand tool set

ENABLING OBJECTIVES

1. Identify and use basic hand tools.
2. Identify procedures to raise and support vehicle safely.
3. Read and interpret a work order.

RESOURCE

Stockel and Stockel. **Auto Service and Repair**, pp. 678-718.

TEACHING ACTIVITIES

1. Have the students read, **Auto Service and Repair**, pp. 678-718.
2. Discuss the importance of parking brakes.
3. Explain the operation of parking brakes.
4. Explain the different types of parking brakes.
5. Have the students raise the vehicle on the lift and locate the parking brake adjustment.
6. Discuss when the parking brake should be adjusted.
7. Demonstrate the correct tension to which the parking brake should be adjusted.
8. Have the students practice adjusting the parking brake linkage to the correct tension.

PERFORMANCE OBJECTIVE 60

CRITERION-REFERENCED MEASURE

Questions

1. What is the purpose of the parking brake?
2. Should the parking brake be adjusted before or after adjusting the service brakes?
3. How tight should the parking brakes be adjusted?

Answers

1. to hold the vehicle when parked and stop the vehicle in an emergency
2. after
3. tight enough to lock the wheel when applied but not so tight as to add drag to wheels when released

Practical Application

Have the students adjust parking braking linkage.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 60 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 60

ADJUSTING PARKING BRAKE LINKAGE

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Must list all parts used.		
3. Raised and supported vehicle.		
4. Loosened lock nut from adjusting nut at cable cross. NOTE: Use penetrating fluid where necessary.		
5. Wire brushed thread on adjuster.		
6. Tightened adjuster until cable has slight tension.		
7. Tightened adjusting lock nut.		
8. Lowered vehicle and checked parking brake operation.		
9. Returned vehicle to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING BRAKE SYSTEM

PERFORMANCE OBJECTIVE 61

TASK

Remove and replace parking brake cable and linkage.

STANDARD OF PERFORMANCE OF TASK

Cable must be routed in same path as original; cable must not bind; and new cable must be adjusted according to manufacturer's specifications.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Rack
Rubber mallet
Basic hand tool set
Hammer

ENABLING OBJECTIVES

1. Identify and use basic hand tools.
2. Identify procedure for raising and supporting vehicle safely.
3. Read and interpret a work order.

RESOURCE

Stockel and Stockel. **Auto Service and Repair,** pp. 678-718.

TEACHING ACTIVITIES

1. Have the students read , **Auto Service and Repair**, pp. 678-718.
2. Discuss the importance of parking brakes.
3. Explain the operation of parking brakes.
4. Explain the different types of parking brakes.
5. Have the student raise and support the vehicle and locate the parking brake components.
6. Discuss the importance of routing the cable properly.
7. Explain the importance of installing all supports in original fashion.
8. Discuss why a new cable must be adjusted to manufacturer's specifications.
9. Have the students practice removing and replacing a parking brake cable.

PERFORMANCE OBJECTIVE 61

CRITERION-REFERENCED MEASURE

Questions

1. What is the purpose of the parking brake?
2. Why should one follow the exact route as the original when removing and replacing a parking brake cable?
3. Is the parking brake hydraulic, pneumatic or mechanical?

Answers

1. to hold the vehicle when in park and to stop the vehicle in an emergency
2. to insure smooth operation and to keep the cable from any moving parts
3. mechanical

Practical Application

Have the students remove and replace parking brake cable and linkage.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 61 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 61

REMOVING AND REPLACING PARKING BRAKE CABLE AND LINKAGE

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Must list all parts used.		
3. Raised and supported vehicle.		
4. Loosened park brake cable adjusting lock nut.		
5. Removed "C" spring clip from rear of front cable.		
6. From inside vehicle, removed clevis pin and cotter pin.		
7. Removed "C" spring clip from front of cable and removed cable from inside vehicle.		
8. Removed supporting bolts from under dash to cable linkage.		
9. Removed linkage assembly.		
10. Replaced parts as necessary.		
11. Reversed procedure for reassembly.		
12. Checked parking brake and returned vehicle to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING BRAKE SYSTEM

PERFORMANCE OBJECTIVE 62

TASK

Remove and replace brake shoes.

STANDARD OF PERFORMANCE OF TASK

Shoes must be adjusted so that vehicle stops in a smooth straight manner; there can be no grease or oil on new shoes.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Rack
Impact wrench set
Screwdriver
Hammer
Rubber mallet
Brake spring pliers
Hold down removing tool
Brake spoon
Silicone grease
Replacement parts
Work order

ENABLING OBJECTIVES

1. Identify and use special brake tools.
2. Use an impact wrench safely.
3. Identify procedure to raise and support vehicle safely.
4. Read and interpret work order.

RESOURCE

Stockel and Stockel. **Auto Service and Repair**, pp. 678-718.

TEACHING ACTIVITIES

1. Have the students read pp. 678-718, **Auto Service and Repair**, which covers brakes.
2. Discuss the safety precautions to be taken, when working with brakes, due to possible hazards associated with asbestos.
3. Discuss the need for clean brake shoes.
4. Explain the difference between the primary and secondary shoes.
5. Demonstrate the correct method of removing and replacing brake shoes using the correct tools.
6. Demonstrate correct method of centering shoes and use of adjusting gauge to get correct shoe to drum fit.
7. Have the students practice removing and replacing brake shoes.

PERFORMANCE OBJECTIVE 62

CRITERION-REFERENCED MEASURE

Questions

1. One should always rebuild the _____ _____ when replacing the worn out brake shoes.
2. What is the dangerous cancer causing material found in some brake shoes?
3. The two brake shoes found in each set are
   a. concentric and contour.
   b. drum and disc.
   c. primary and secondary.
   d. parking and service.

Answers

1. wheel cylinder
2. asbestos
3. c

Practical Application

Have the students remove and replace brake shoes.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 62 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 62

REMOVING AND REPLACING BRAKE SHOES

Student's Name _____ **Date** _____

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the task within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Must list all parts used.		
3. Raised and supported vehicle.		
4. Removed tire and wheel assembly.		
5. Removed drum. CAUTION: Some old brake pads are made of asbestos, do not breathe dust caused by cleaning drum. NOTE: May be necessary to loosen brake adjustment.		
6. Removed brake shoes, hold down springs and clips.		
7. Removed return springs. NOTE: (If Rear) Removed park brake loop or clip.		
8. Placed shoes on floor and removed adjuster and adjusted spring.		
9. Cleaned backing plate and greased ride pads.		
10. Replaced new parts as necessary.		
11. Replaced adjusting spring and adjuster on shoes.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 62

REMOVING AND REPLACING BRAKE SHOES

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
12. Placed shoes on backing plate with hold down spring and clips.		
13. Hooked return springs.		
14. Fastened park brake cable to shoes.		
15. Replaced drum.		
16. Adjusted brake.		
17. Replaced wheel and tire assembly.		
18. Replaced brake fluid to required level at master cylinder.		
19. Lowered vehicle and road tested.		
20. Returned vehicle to service.		

APPROVED: YES _____ NO _____

_____

Evaluator's Signature Date

DUTY MAINTAINING BRAKE SYSTEM

PERFORMANCE OBJECTIVE 63

TASK

Remove and replace disk brake pads.

STANDARD OF PERFORMANCE OF TASK

New brakes must be adjusted so that vehicle stops in a smooth straight manner; there can be no grease or oil on new pads.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Rack
Impact wrench set
Hammer
Rubber mallet
Allen wrenches
6 inch C-clamp
Basic hand tool set
Replacement parts
Work order

ENABLING OBJECTIVES

1. Identify and use basic hand tools.
2. Raise and support vehicle safely.
3. Read and interpret work order.

RESOURCE

Stockel and Stockel. **Auto Service and Repair,** pp. 678-718.

TEACHING ACTIVITIES

1. Discuss, with the students, the different types of disc brakes and how the pads are replaced on them.
2. Explain how the caliper works.
3. Demonstrate the correct method of removing and replacing disc brake pads using a "C" clamp or caliper spreader tool.
4. Discuss why one should always inspect the caliper, and disc when replacing pads.
5. Demonstrate how caliper should be checked for centering over disc.
6. Discuss how normal brake pedal must be obtained by pumping the pedal before putting the vehicle in gear.
7. Have the students practice removing and replacing disc brake pads.

PERFORMANCE OBJECTIVE 63

CRITERION-REFERENCED MEASURE

Questions

1. What causes the pads to grip the disc?
2. Name two types of disc brake calipers?
3. What must be done before forcing the caliper piston back into the bore?
   a. remove the old brake pads
   b. install the new brake pads
   c. remove sufficient fluid from the reservoir
   d. fill reservoir to top

Answers

1. hydraulic pressure forcing caliper pistons out
2. floating caliper and fixed caliper
3. c

Practical Application

Have the students remove and replace disc brake pads.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 63 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 63

REMOVING AND REPLACING DISC BRAKE PADS

Student's Name _____ **Date** _____

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the task within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Must list all parts used.		
3. Raised and supported front of vehicle.		
4. Removed front tire and wheel assembly.		
5. Removed caliper holding pins and lock.		
6. Slid caliper up and supported with wire to top of a frame.		
7. Removed pads observing positions of retaining clips.		
8. Removed clips where applicable.		
9. Using C-clamp, positioned caliper piston in seat.		
10. Replaced pad clips (if applied).		
11. Placed pads in caliper. NOTE: Disc brakes quieter on metal side of pads. Use silicone on squeaky pads.		
12. Cleaned rotor with sand paper.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 63

REMOVING AND REPLACING DISC BRAKE PADS

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
13. Positioned caliper on rotor.		
14. Replaced caliper ride pins and O-rings.		
15. Installed tire and wheel assemblies.		
16. Pressed and repressed brake pedal several times. NOTE: No more than 1" stroke at a time until pedal returns to normal.		
17. Lowered vehicle.		
18. Raised hood and removed master cylinder cover.		
19. Filled master cylinder and replaced cap.		
20. Road tested and returned vehicle to service.		

APPROVED: YES _____ NO _____

_____

Evaluator's Signature Date

DUTY MAINTAINING BRAKE SYSTEM

PERFORMANCE OBJECTIVE 64

TASK

Remove and replace self adjusters.

STANDARD OF PERFORMANCE OF TASK

New brake shoes must be adjusted so that vehicle stops in a smooth straight manner; there can be no grease or oil on new pads.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Rack
Impact wrench
Screwdriver
Hammer
Rubber mallet
Brake spring pliers
Hold down removing tool
Brake spoon
Replacement parts
Silicone grease
Work order

ENABLING OBJECTIVES

1. Identify and use special brake tools.
2. Raise and support vehicle safely.
3. Read and interpret a work order.

RESOURCE

Stockel and Stockel. **Auto Service and Repair,** pp. 678-718.

TEACHING ACTIVITIES

1. Have the students read, **Auto Service and Repair,** pp. 678-718.
2. Discuss with the students the importance of doing thorough and complete brake work the first time.
3. Explain the way self adjusters work.
4. Have the students raise and support the vehicle.
5. Have the students remove the wheel and tire assembly.
6. Have the students remove the brake drum.
7. With brake adjusters exposed, demonstrate how each part works.
8. Demonstrate correct method of removing and replacing the adjusters.
9. Have the students practice removing and replacing the adjusters.

PERFORMANCE OBJECTIVE 64

CRITERION-REFERENCED MEASURE

Questions

1. When do the self adjusters work?
2. In order to remove the self adjuster one must
   a. remove the wheel and tire assembly only.
   b. remove the wheel cylinder on the affected wheel.
   c. remove the brake drum.
   d. none of the above.
3. Because of possible health hazards one should never blow brake dust into the air, instead one should use an approved _____ source to remove the dust.

Answers

1. when reverse stops are made
2. c
3. vacuum

Practical Application

Have the students remove and replace self adjusters.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 64 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 64

REMOVING AND REPLACING SELF ADJUSTERS

Student's Name _____ **Date** _____

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Must list all parts used.		
3. Raised and supported wheels to be worked on.		
4. Removed tire and wheel assemblies on wheels to be repaired.		
5. Removed drums. NOTE: May be necessary to loosen brake adjustments.		
6. Cleaned old dust with air hose. CAUTION: Cover nose and mouth, as dust is dangerous to lungs.		
7. Removed adjustment spring. NOTE: In some cases it may be necessary to remove rear hold down springs.		
8. Pulled bottoms of shoes apart and removed adjusters.		
9. Inspected and freed threads on adjusters.		
10. Placed adjusters between bottom of shoes.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 64

REMOVING AND REPLACING SELF ADJUSTERS

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
11. Installed adjuster spring.		
12. Installed drum.		
13. Adjusted shoes to obtain slight drag on drum.		
14. Installed tire and wheel assembly.		
15. Lowered vehicle, road tested and returned to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature Date

DUTY MAINTAINING BRAKE SYSTEM

PERFORMANCE OBJECTIVE 65

TASK

Remove and replace wheel cylinders.

STANDARD OF PERFORMANCE OF TASK

Cylinder must not leak; system must not be "springy; " and system must be bled.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Rack
Impact wrench
Screwdriver
Hammer
Rubber mallet
Brake spring pliers
Hold down removing tool
Brake spoon
Line wrenches
Silicone grease
Basic hand tool set

ENABLING OBJECTIVES

1. Read and interpret a work order.
2. Raise and support vehicle safely.
3. Identify and use special brake tools.

RESOURCE

Stockel and Stockel. **Auto Service and Repair,** pp. 678-718.

TEACHING ACTIVITIES

1. Have the students read, **Auto Service and Repair,** pp. 678-718.
2. Discuss how the wheel cylinder works.
3. Explain why there can be no air in brake system.
4. Discuss possible health hazards associated with the asbestos found in some brake shoes.
5 Have the students raise and support vehicle and remove the wheel and tire assembly and the brake drum.
6. Demonstrate the correct method for removing and replacing the wheel cylinder.
7. Explain how the affected wheel must be adjusted and the air bled from the cylinder.
8. Have the students practice removing and replacing wheel cylinders.

PERFORMANCE OBJECTIVE 65

CRITERION-REFERENCED MEASURE

Questions

1. The wheel cylinder is operated by
   a. an electric motor.
   b. hydraulic pressure.
   c. air pressure.
   d. vacuum.
2. What causes the brakes to feel spongy?
3. When the brakes are applied the wheel cylinder forces the brake shoes against the _____.

Answers

1. b
2. air in the system
3. drum

Practical Application

Have the students remove and replace a wheel cylinder.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 65 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 65

REMOVING AND REPLACING WHEEL CYLINDERS

Student's Name _____ **Date** _____

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Must list all parts used.		
3. Raised and supported vehicle at wheel to be worked on.		
4. Removed tire and wheel assemblies.		
5. Removed drum (may be necessary to loosen brake adjuster). CAUTION: Some old brake pads are made of asbestos, do not breathe dust caused by cleaning drum.		
6. Removed brake shoes.		
7. Removed brake line at cylinder.		
8. Removed attaching bolts.		
9. Removed cylinder, inspected and renewed if necessary.		
10. Bolted cylinder in place.		
11. Installed line.		
12. Installed shoes.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 65

REMOVING AND REPLACING WHEEL CYLINDERS

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
13. Installed drum.		
14. Adjusted shoes, bled wheel worked on.		
15. Installed tire and wheel assemblies.		
16. Lowered vehicle.		
17. Checked brake fluid level.		
18. Road tested and returned vehicle to service.		

APPROVED: YES _____ NO _____

_____

Evaluator's Signature Date

DUTY MAINTAINING BRAKE SYSTEM

PERFORMANCE OBJECTIVE 66

TASK

Rebuild wheel cylinder.

STANDARD OF PERFORMANCE OF TASK

Rebuilt cylinder must not leak.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Cylinder hone
Drill
Vise
Screwdriver
Brake fluid
Replacement parts
Work order

ENABLING OBJECTIVES

1. Read and interpret a work order.
2. Identify and use cylinder hone.
3. Identify correct replacement parts.

RESOURCE

Stockel and Stockel. **Auto Service and Repair,** pp. 678-718.

TEACHING ACTIVITIES

1. Have the students read, **Auto Service and Repair,** pp. 678-718.
2. Discuss the purpose of the wheel cylinder and the principle on which it works.
3. Discuss why a wheel cylinder leaks and why it must be rebuilt.
4. Discuss the different types of wheel cylinders.
5. Explain why all parts should be washed in denatured alcohol and blown dry.
6. Demonstrate the correct method of honing the cylinder.
7. Demonstrate the correct method of checking the clearance between the piston and the cylinder.
8. Demonstrate reassembling the reconditioned cylinder.
9. Have the students practice rebuilding a wheel cylinder.

PERFORMANCE OBJECTIVE 66

CRITERION-REFERENCED MEASURE

Questions

1. When should wheel cylinders be reconditioned?
2. Which one of the following should a mechanic use to clean wheel cylinder parts?
   a. soap and water
   b. denatured alcohol
   c. boric acid
   d. cleaning solvent
3. Which one of the following should a mechanic use to coat the wheel cylinder parts prior to reassembling?
   a. a light silicone grease
   b. a general purpose grease
   c. light grade engine oil
   d. brake fluid

Answers

1. anytime the cylinder leaks or anytime the brakes are relined
2. b
3. d

Practical Application

Have the students rebuild a wheel cylinder.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 66 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 66

REBUILDING A WHEEL CYLINDER

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. As score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Must list all parts used.		
3. Placed cylinder in work vise. NOTE: Make sure bleed valve will loosen.		
4. Removed dust covers, cups and return spring.		
5. Honed cylinder using brake fluid as lubricant. NOTE: Made sure bleed valve will loosen.		
6. Inspected cylinder bore.		
7. Lubricated internal parts with brake fluid.		
8. Installed new return spring, cups on both sides and dust cover boots. NOTE: Bleed valve should be replaced with new one.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING BRAKE SYSTEM

PERFORMANCE OBJECTIVE 67

TASK

Grind (turn) brake drum.

STANDARD OF PERFORMANCE OF TASK

All damage must be removed; do not exceed manufacturer's specifications for drum thickness.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Disc drum lathe
Work order
Shop manual

ENABLING OBJECTIVES

1. Read and interpret a work order.
2. Read and interpret a shop manual.
3. Operate a brake lathe.

RESOURCE

Stockel and Stockel. **Auto Service and Repair,** pp. 701-02.

TEACHING ACTIVITIES

1. Discuss the method of inspecting a brake drum prior to grinding.
2. Explain the maximum limits for roundness and trueness of a brake drum.
3. Discuss safety precautions connected with grinding a brake drum.
4. Demonstrate the correct method of grinding a drum on a lathe.
5. Demonstrate turning a brake drum.
6. Explain why drums should be turned in pairs, fronts and rears.
7. Have the students practice mounting and grinding a brake drum.
8. Discuss safety rules and proper measuring techniques.

PERFORMANCE OBJECTIVE 67

CRITERION-REFERENCED MEASURE

Questions

1. Which of the following statements is true?
   a. Weld only the cracks in brake drums that are longitudinal.
   b. Never attempt to weld a brake drum.
   c. Small cracks may be welded in brake drums if the weld does not interfere with the braking surface.
   d. Weld a cracked brake drum with a MIG welder only.
2. The maximum a brake drum should measure above standard diameter after turning is _____.
   a. .006
   b. .600
   c. .010
   d. .060
3. The final cut when turning a brake drum should be _____ and _____ in order to produce a satisfactory finish.

Answers

1. b
2. d
3. fine, slow

Practical Application

Have the students grind (turn) a brake drum.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 67 to determine if the assignment was complete for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 67

GRINDING (TURNING) A BRAKE DRUM

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Installed drums on lathe.		
3. Machined as necessary according to manufacturer's specifications. NOTE: Gauge drum before machining for correct specifications.		
4. Removed drum from lathe.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING BRAKE SYSTEM

PERFORMANCE OBJECTIVE 68

TASK

Remove and replace disc brake rotor.

STANDARD OF PERFORMANCE OF TASK

Spindle nut must be tightened to manufacturer's specifications; there can be no radial play.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Rack
Basic hand tool set
Hammer
Rubber mallet
Allen wrenches
6 inch C-clamp
Diagonal cutters
Safety pins
Brass bar stock of 1/2" diameter
Replacement parts
Work order

ENABLING OBJECTIVES

1. Identify and use basic hand tools.
2. Raise and support vehicle safely.
3. Read and interpret a work order.

RESOURCE

Stockel and Stockel. **Auto Service and Repair**, pp. 703-15.

TEACHING ACTIVITIES

1. Discuss the purpose of the disc brake rotor.
2. Discuss some of the reasons for changing from drum brakes to disc brakes.
3. Demonstrate the correct method of removing the caliper.
4. Demonstrate the correct way of removing and replacing the brake rotor.
5. Have the students review the manufacturer's specifications for proper bearing adjustment when replacing the rotor.
6. Have the students practice removing and replacing the disc brake rotor.
7. Discuss the technique for regaining normal brake pedal travel.

PERFORMANCE OBJECTIVE 68

CRITERION-REFERENCED MEASURE

Questions

1. Once the wheel and tire assembly has been removed the correct sequence of removal of the rotor is
   a. remove bearing keeper, outer bearing, nut lock, cotter pin, nut, caliper, inner bearing and the rotor.
   b. remove caliper, cotter pin, nut lock, nut, washer, outer bearing and rotor.
   c. remove caliper, cotter pin, nut lock, nut, washer, outer bearing, inner bearing, and rotor.
   d. remove caliper, cotter pin, nut, washer, inner bearing, rotor.
2. Disc brakes are highly resistant to _____ (due to loss of friction from overheating).
3. If the caliper piston was depressed for removal and/or replacing how do you regain normal brake pedal travel?

Answers

1. b
2. fading
3. by pumping the brake pedal lightly several times

Practical Application

Have the students remove and replace a disc brake rotor.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 68 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 68

REMOVING AND REPLACING A DISC BRAKE ROTOR

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Must list all parts used.		
3. Raised and supported wheel to be repaired.		
4. Removed tire and wheel assembly.		
5. Removed caliper through bolts and caliper.NOTE: Sometimes it's necessary to depress piston to remove caliper.		
6. Removed outer bearing dust cover.		
7. Removed cotter pin and nut lock.		
8. Removed nut and washer.		
9. Removed outer bearing. NOTE: Bearing seals must be inspected and replaced if necessary.		
10. Removed disc rotor.		
11. Reversed procedure of reassembly.		
12. Tested brake system and returned vehicle to service.		

APPROVED: YES _____ NO ____

Evaluator's Signature **Date**

DUTY MAINTAINING BRAKE SYSTEM

PERFORMANCE OBJECTIVE 69

TASK

Remove and replace caliper assembly.

STANDARD OF PERFORMANCE OF TASK

Caliper must be firmly mounted; there can be no leaks.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Rack
Impact wrench
Hammer
Rubber mallet
Screwdrivers
6 inch C-clamp
Allen wrenches
Vise grips
Open box wrenches
Replacement parts
Work order

ENABLING OBJECTIVES

1. Read and interpret a work order.
2. Identify and use basic hand tools.
3. Raise and support vehicle safely.

RESOURCE

Stockel and Stockel. **Auto Service and Repair,** pp. 708-15.

TEACHING ACTIVITIES

1. Discuss the purpose and operation of the brake caliper.
2. Explain the necessity of noting the method of caliper mounting and the position of mounting hardware.
3. Explain that one must hold the hose and turn the caliper to remove the caliper.
4. Demonstrate the correct procedure for removing and replacing a disc brake caliper.
5. Explain why the brake line must be bled when the hose is disconnected.
6. Have the students practice removing and replacing a disc brake caliper.

PERFORMANCE OBJECTIVE 69

CRITERION-REFERENCED MEASURE

Questions

1. Which of the following causes the disc brake caliper to operate?
   a. an electrical solenoid
   b. vacuum
   c. hydraulic pressure
   d. air pressure
2. Why should one give particular attention to the mounting of each caliper before removing and during removal?
3. Why is it necessary to bleed the brakes after replacing the caliper?

Answers

1. c
2. All calipers are not mounted alike and some are shimmed which should be reinstalled in original positions.
3. Since the hose was removed, there will be air in the system.

Practical Application

Have the students remove and replace a caliper assembly.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 69 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 69

REMOVING AND REPLACING A CALIPER ASSEMBLY

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Listed all parts used.		
3. Raised and supported wheel to be worked on.		
4. Raised tire and wheel assembly.		
5. Removed caliper through pins (some types have clips on pins).		
6. Removed brake line at inner side.		
7. Reversed procedures.		
8. Road tested and returned vehicle to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING BRAKE SYSTEM

PERFORMANCE OBJECTIVE 70

TASK

Rebuild caliper assembly.

STANDARD OF PERFORMANCE OF TASK

Rebuilt caliper assembly must not leak; piston in rebuilt caliper assembly must move freely.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Impact wrench
6 inch C-clamp
Rubber mallet
Hone
Allen wrenches
Work order
Vise grips
Drill

ENABLING OBJECTIVES

1. Read and interpret a work order.
2. Identify and use basic hand tools.
3. Use compressed air safely.

RESOURCE

Stockel and Stockel. **Auto Service and Repair,** pp. 708-18.

TEACHING ACTIVITIES

1. Have the students read, **Auto Service and Repair,** pp. 708-18.
2. Discuss construction of disc brake calipers.
3. Demonstrate the different methods of removing the caliper piston from the pistons.
4. Explain why alcohol is best for cleaning brake parts.
5. Demonstrate the correct method of rebuilding a brake caliper assembly.
6. Have the students practice rebuilding a caliper assembly.

PERFORMANCE OBJECTIVE 70

CRITERION-REFERENCED MEASURE

Questions

1. Brake pressure should be used to remove phenolic pistons from caliper bore but _____ pressure may be used to remove cast iron pistons.
2. Which of the following is the maximum amount by which the caliper bore may be increased over standard bore?
   a. .01 in.
   b. .001 in.
   c. .010 in.
   d. 1.0 in.
3. A caliper cylinder bore in quite good condition can often be cleaned by hand, using
   a. 100 grit sand paper.
   b. 150 grit sand paper.
   c. crocus cloth.
   d. soap and water.

Answers

1. air
2. b
3. c

Practical Application

Have the students rebuild a caliper assembly.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 70 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 70

REBUILDING A CALIPER ASSEMBLY

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Must list all parts used.		
3. Placed on bench. NOTE: Placed on cloth to absorb fluid.		
4. Removed outer dust seal.		
5. Removed pistons with piston removing tool.		
6. Removed inner seal.		
7. Removed bleeder valve.		
8. Honed cylinder.		
9. Replaced all worn parts with new parts.		
10. Installed new seals. NOTE: Coat all inner parts with brake fluid.		
11. Installed pistons. NOTE: It may be necessary to use C-clamp.		
12. Installed outer seal.		
13. Installed bleeder valves.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING BRAKE SYSTEM

PERFORMANCE OBJECTIVE 71

TASK

Remove and replace master cylinder.

STANDARD OF PERFORMANCE OF TASK

Replacement cylinder must not leak; replacement cylinder must be bled of air.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Basic hand tool set
Line wrenches
Screwdriver
Vise
Brake fluid
Replacement parts
Work order

ENABLING OBJECTIVES

1. Read and interpret a work order.
2. Identify and use basic hand tools.

RESOURCE

Stockel and Stockel. **Auto Service and Repair,** pp. 680-88.

TEACHING ACTIVITIES

1. Discuss the purpose and operation of a master cylinder.
2. Discuss the different types of master cylinders.
3. Explain the importance of keeping brake fluid off painted surfaces.
4. Demonstrate removal of brake lines from master cylinder.
5. Explain why the master cylinder must be bled after the lines are reinstalled.
6. Have the students practice removing and replacing a master cylinder and bleeding the air out of it.

PERFORMANCE OBJECTIVE 71

CRITERION-REFERENCED MEASURE

Questions

1. Name two types of master cylinders.
2. If there are no bleed parts on a master cylinder, how do you bleed the air out of it?
3. What type of wrench should be used to loosen and tighten the brake lines?

Answers

1. single type and tandem or dual type
2. by loosening the lines on the master cylinder one at a time
3. a flare nut or line wrench

Practical Application

Have the students remove and replace a master cylinder.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 71 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 71

REMOVING AND REPLACING A MASTER CYLINDER

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Must list all parts used.		
3. Raised hood and placed cloth under master cylinder to catch any loose fluid. NOTE: Brake fluid takes off paint, be careful.		
4. Removed both lines.		
5. Removed housing bolts.		
6. Removed master cylinder.		
7. Installed master cylinder.		
8. Installed master cylinder bolts.		
9. Installed brake lines.		
10. Filled master cylinder with brake fluid.		
11. Loosened one line at a time and bled all air out.		
12. Rechecked fluid.		
13. Checked pedal free play.		
14. Removed cloth and closed hood.		
15. Road tested and returned vehicle to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING BRAKE SYSTEM

PERFORMANCE OBJECTIVE 72

TASK

Remove and replace hydro-brake booster unit.

STANDARD OF PERFORMANCE OF TASK

Replacement assembly must not leak vacuum.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Rack
Basic hand tool set
Line wrenches
Vise
Screwdriver
Replacement parts
Work order

ENABLING OBJECTIVES

1. Identify and use basic hand tools.
2. Read and interpret a work order.
3. Identify replacement parts.

RESOURCE

Stockel and Stockel. **Auto Service and Repair,** pp. 687-91.

TEACHING ACTIVITIES

1. Have the students read, **Auto Service and Repair,** pp. 687-91.
2. Discuss the operation and purpose of the vacuum brake booster unit.
3. Explain how to determine if the booster is defective.
4. Demonstrate the correct method of removing and replacing the booster.
5. Have the students practice removing and replacing a vacuum brake booster unit.

PERFORMANCE OBJECTIVE 72

CRITERION-REFERENCED MEASURE

Questions

1. The brake unit booster receives its power from which of the following?
   a. hydraulic pressure
   b. electrical pump
   c. intake vacuum
   d. mechanical pump

2. When removing and replacing a brake booster unit, why should one always follow the manufacturer's procedures?

3. One method of checking a brake booster is with a hand _____ pump.

Answers

1. c
2. all boosters are not exactly alike
3. vacuum

Practical Application

Have the students remove and replace vacuum brake booster unit.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 72 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 72

REMOVING AND REPLACING VACUUM BRAKE BOOSTER UNIT

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to all of the items which are to be evaluated. Be sure the student completes the task within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Listed all parts used.		
3. Raised hood and removed master cylinder housing bolts. NOTE: On some models it may be necessary to remove master cylinder and line.		
4. Slid master cylinder back far enough to clear activator rod.		
5. Removed vacuum booster mounting bolts. NOTE: In some models it will be necessary to remove brake activator rod from inside vehicle at brake pedal.		
6. Made repair or replaced defective unit.		
7. Reversed procedure. NOTE: Bled master cylinder if lines were loosened.		
8. Road tested and returned vehicle to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING BRAKE SYSTEM

PERFORMANCE OBJECTIVE 73

TASK

Bleed brake system.

STANDARD OF PERFORMANCE OF TASK

There can be no air present in brake system.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Rack
Screwdriver
Socket set
Open box wrenches
Penetrating sealer
Work order

ENABLING OBJECTIVES

1. Identify and use basic hand tools.
2. Raise and support vehicle safely.
3. Read and interpret a work order.

RESOURCE

Stockel and Stockel. **Auto Service and Repair**, pp. 678-718.

TEACHING ACTIVITIES

1. Explain what is meant by bleeding a brake system.
2. Explain why the brake system cannot have air in it.
3. Explain the different methods of bleeding the brake system.
4. Explain the proper sequence in bleeding the brake system.
5. Demonstrate the proper method of bleeding brakes.
6. Have the students practice bleeding the brake system until there is no air in the system.

PERFORMANCE OBJECTIVE 73

CRITERION-REFERENCED MEASURE

Questions

1. Name two common methods of bleeding brakes.
2. If the complete brake system is to be bled what point or part should be bled first?
3. By using a _____ _____ only one person is required to bleed the brake system.

Answers

1. manual bleeding and pressure bleeding
2. the master cylinder
3. pressure tank

Practical Application

Have the students bleed the brake system.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 73 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 73

BLEEDING THE BRAKE SYSTEM

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: List all parts used.		
3. Raised hood and checked brake fluid level.		
4. Raised and supported vehicle.		
5. Placed hose on each bleeder and flushed.		
6. Using helper to operate pedal, opened bleeder to longest line and slightly pushed pedal approximately 2".		
7. Closed bleeder and proceeded to next wheel until all have been bled.		
8. Rechecked fluid and closed hood.		
9. Lowered vehicle and road tested.		
10. Returned vehicle to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING BRAKE SYSTEM

PERFORMANCE OBJECTIVE 74

TASK

Remove and replace proportioning valve (combination valve).

STANDARD OF PERFORMANCE OF TASK

Replacement proportioning valve must be adjusted for correct front to rear brake fluid pressure; there can be no leaks.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Rack
Line wrenches
Basic hand tool set
Work order

ENABLING OBJECTIVES

1. Identify and use basic hand tools.
2. Raise and support vehicle safely.
3. Read and interpret a work order.

RESOURCE

Stockel and Stockel. **Auto Service and Repair,** pp. 678-718.

TEACHING ACTIVITIES

1. Have the students read and discuss, **Auto Service and Repair,** pp. 678-718.
2. Discussthe purpose of a proportioning valve.
3. Demonstrate how the proportioning valve works.
4. Explain the different types of proportioning valves.
5. Discuss why proportioning valves should not be overhauled.
6. Have the students practice removing and replacing a proportioning valve.

PERFORMANCE OBJECTIVE 74

CRITERION-REFERENCED MEASURE

Questions

1. Which one of the following valves is placed in a disc/drum brake system to control the pressure to the rear drum brake to reduce the possibility of rear brake lock-up under heavy braking?
   a. metering valves
   b. proportioning valve
   c. pressure differential switch valve
   d. accumulator
2. If, when inspecting the brake system, the combination valve is found defective what should be done?
   a. repair the valve as necessary
   b. replace the valve, do not attempt to repair
   c. by-pass the valve, it serves no purpose
   d. none of the above, the combination valve is not in the brake system

Answers

1. b
2. b

Practical Application

Have the students remove and replace a proportioning valve (combination valve).

Method of Evaluating Practical Application

Use Checklist For Performance Objective 74 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 74

REMOVING AND REPLACING PROPORTIONING VALVE (COMBINATION VALVE)

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the task within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Listed all parts used.		
3. Raised and supported vehicle.		
4. Raised hood.		
5. Removed brake lines using line wrenches.		
6. Removed frame mounting bolts.		
7. Replaced valve.		
8. Mounted to frame.		
9. Installed all lines. NOTE: Some models have a hold button to hold in while bleeding.		
10. Loosened one line at a time and let fluid run out.		
11. Closed line.		
12. After bleeding all lines, lowered vehicle.		
13. Rechecked brake fluid.		
14. Road tested and returned vehicle to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING BRAKE SYSTEM

PERFORMANCE OBJECTIVE 75

TASK

Test brake anti-lock system.

STANDARD OF PERFORMANCE OF TASK

Under panic-stop situations, all skid tendencies must be detected and noted.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Vehicle with faulty brake anti-lock systems
Work order

ENABLING OBJECTIVES

1. Read and interpret a work order.
2. Have a valid drivers license.

RESOURCE

Toboldt, Johnson and Olive. **Automotive Encyclopedia,** pp. 654-57, 672.

TEACHING ACTIVITIES

1. Read and discuss, **Automotive Encyclopedia,** pp. 654-57, 672.
2. Explain the purpose of a brake anti-lock system.
3. Discuss the operation of brake anti-lock system.
4. Explain the method of operationally checking the anti-lock brake system.
5. Using a vehicle with anti-lock defects, have the students practice troubleshooting. Caution students to observe all safety precautions.

PERFORMANCE OBJECTIVE 75

CRITERION-REFERENCED MEASURE

Questions

1. What is the purpose of the anti-lock brake system?
2. The anti-lock system is most effective
   a. at high speeds.
   b. at low speeds.
   c. under normal braking.
   d. under heavy braking.
3. On a vehicle with an anti-lock braking system one wheel skids, the most probable cause is
   a. brake caliper bad.
   b. disc rotor out of round.
   c. anti-lock sensor bad.
   d. not a problem because anti-lock system only works in pairs.

Answers

1. to prevent wheels from skidding under heavy braking
2. d
3. c

Practical Application

Have the students test brake anti-lock system.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 75 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 75

TESTING BRAKE ANTI-LOCK SYSTEM

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Selected safe work area. CAUTION: Use care when selecting safe area to test brake anti-lock system. There must be ample room for movement of vehicle. Notify all workers in the area so that no one will be walking in front of vehicle while test is being conducted.		
3. Drove vehicle into test area.		
4. With vehicle idling, depressed brake pedal.		
5. Put transmission selector in drive and accelerated engine slightly. NOTE: The electronic sensor should cycle 5 or 6 times.		
6. Gradually released brake pressure to allow vehicle to move forward.		
7. Noted findings on work order.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING BRAKE SYSTEM

PERFORMANCE OBJECTIVE 76

TASK

Replace defective components in brake anti-lock system.

STANDARD OF PERFORMANCE OF TASK

All defective parts must be detected and replaced.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Service manual
Volt ohm meter
Basic hand tool set
Replacement parts
Lift
Work order

ENABLING OBJECTIVES

1. Identify and use basic hand tools.
2. Read and interpret service manual.
3. Read and interpret a work order.
4. Identify and use volt/ohm meter.

RESOURCES

1. **1987 Corvette Service Manual,** Section 5E, pp. 1-8.
2. Toboldt, Johnson and Olive. **Automotive Encyclopedia,** pp. 654-57.
3. Webster. **Auto Mechanics,** pp. 472-73.
4. **Mitchell Automechanics,** pp. 572-73.
5. deKryger, Kobacik and Bono. **Auto Mechanics: Theory and Service,** pp. 461, 698.

TEACHING ACTIVITIES

1. Explain the function of the Anti-Lock Brake System.
2. Explain how the Anti-Lock Brake System performs its function.
3. Explain the function of the parts for the ABS which work in conjunction with the standard brake system.
4. Discuss the need to follow the manufacturer's instructions.
5. Demonstrate the correct procedure for using the ABS diagnostic tester.
6. Have the students remove and replace defective components.

PERFORMANCE OBJECTIVE 76

CRITERION-REFERENCED MEASURE

Questions

1. How many wheel speed sensors are there in the Anti-Lock Brake System?
2. What repairs can be made on the ABS modulator valve?
3. After repairs are made on the ABS system what must be done to the system?

Answers

1. four (4)
2. no repairs permissible
3. entire system must be checked using an ABS diagnostic tester

Practical Application

Have the students replace defective components in the brake anti-lock system.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 76 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 76

REPLACING DEFECTIVE COMPONENTS IN BRAKE ANTI-LOCK SYSTEM

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Recorded starting time. NOTE: Listed all parts used.		
3. Raised vehicle.		
4. Checked sensor mounted on rear of axle housing. Replaced if found defective.		
5. Checked actuator mounted near front cross member of left frame rail.		
6. Lowered vehicle and checked control module mounted near glove box. NOTE: When new parts are installed, the system must be bled.		
7. Test drove and returned vehicle to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING BRAKE SYSTEM

PERFORMANCE OBJECTIVE 77

TASK

Test rotor parallelism.

STANDARD OF PERFORMANCE OF TASK

Any reading exceeding manufacturer's specifications must be detected and noted on work order.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Dial indicator
Work order

ENABLING OBJECTIVES

1. Identify and use a micrometer.
2. Read and interpret a work order.

RESOURCES

1. **Cavalier Shop Manual,** pp. 5-8.
2. Toboldt, Johnson and Olive. **Automotive Encyclopedia,** p. 639.
3. Duffy. **Modern Automotive Mechanics,** p. 897.

TEACHING ACTIVITIES

1. Discuss the definition of "parallelism".
2. Discuss the need for checking rotor parallelism.
3. Discuss rotor refinishing specifications.
4. Demonstrate how to check rotor parallelism with a micrometer.
5. Have the students practice checking rotor parallelism with a micrometer.

PERFORMANCE OBJECTIVE 77

CRITERION-REFERENCED MEASURE

Questions

1. Brake rotor parallelism is a check of the _____ of the rotor.

2. When checking rotor parallelism it should be made at least at _____ different points around the circumference of the rotor.

3. The maximum variation on a rotor parallelism should not exceed
   a. .13 mm (.005").
   b. 1.3 mm (.05").
   c. .013 mm (.0005").
   d. 13 mm (.5").

Answers

1. thickness
2. four
3. c

Practical Application

Have the students test a rotor for parallelism.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 77 to determine if the assignment was complete for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 77

TESTING ROTOR PARALLELISM

Student's Name _____ Date _____

DIRECTIONS TO STUDENT: Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the task within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Raised and supported wheel to be worked on.		
3. Removed tire and wheel assembly.		
4. Took micrometer reading from at least four different points around the circumference of the rotor. NOTE: Each measurement must be taken the same distance from the wear edge (about 1 inch).		
5. Recorded findings on work order.		
6. Subtracted smallest reading from largest reading and compared to manufacturer's specifications.		
7. Replaced wheel and tire assembly.		
8. Lowered vehicle and returned it to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature _____ Date _____

DUTY MAINTAINING BRAKE SYSTEM

PERFORMANCE OBJECTIVE 78

TASK

Test rotor run-out.

STANDARD OF PERFORMANCE OF TASK

Any rotor run-out must be detected and noted on work order.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Rack
Impact wrench
Hammer
6 inch C-clamp
Rubber mallet
Basic hand tool set
Diagonal cutters
Channel locks
Brass bar stock of $\frac{1}{2}$" diameter
Safety pins
Dial indicator

ENABLING OBJECTIVES

1. Identify and use basic hand tools.
2. Identify and use dial indicator.
3. Raise and support vehicle safely.
4. Read and interpret a work order.

RESOURCE

Stockel and Stockel. **Auto Service and Repair**, p. 713.

TEACHING ACTIVITIES

1. Explain what rotor run-out is.
2. Discuss why it is necessary to check rotor run-out.
3. Discuss the manufacturer's wheel bearing specifications before checking run-out.
4. Discuss the correct procedure for setting up the dial indicator.
5. Demonstrate setting up the dial indicator and slowly rotating the disc while reading the dial.
6. Have the students practice setting up the dial indicator and checking rotor run-out.

PERFORMANCE OBJECTIVE 78

CRITERION-REFERENCED MEASURE

Questions

1. What is rotor run-out?
2. What instrument should be used to check rotor run-out?
3. What must be checked for proper adjustment prior to checking rotor run-out?

Answers

1. side to side wobble
2. dial indicator
3. wheel bearings

Practical Application

Have the students test rotor run-out.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 78 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 78

TESTING ROTOR RUN-OUT

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Raised and supported wheels to be worked on.		
3. Removed tire and wheel assembly.		
4. Depressed caliper piston slightly to free rotor rotation.		
5. Removed outer bearing dust cover.		
6. Removed cotter pin and adjusted wheel bearing according to manufacturer's specifications.		
7. Replaced cotter pin and dust cover.		
8. Placed dial indicator on spindle support with indicator touching rotor.		
9. Rotated rotor and noted readings on work order.		
10. Replaced tire and wheel assemblies on work order.		
11. Torqued wheel nuts according to manufacturer's specifications.		
12. Lowered vehicle and returned it to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING BRAKE SYSTEM

PERFORMANCE OBJECTIVE 79

TASK

Torque wheel lug nuts.

STANDARD OF PERFORMANCE OF TASK

All wheel nuts must be torqued evenly and to manufacturer's specifications.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Screwdrivers
Torque wrench
Rubber mallet
Sockets
Work order

ENABLING OBJECTIVES

1. Read and interpret a work order.
2. Identify and use a torque wrench.
3. Raise and support vehicle safely.

RESOURCE

Stockel and Stockel. **Auto Mechanics Fundamentals,** pp. 393-94.

TEACHING ACTIVITIES

1. Discuss the importance of torquing wheel lug nuts properly.
2. Discuss why the nuts must be torqued evenly.
3. Discuss the need for handling wheel covers carefully.
4. Demonstrate the correct method of torquing the wheel nuts (depending on the number of nuts).
5. Have the students practice torquing wheel lug nuts.

PERFORMANCE OBJECTIVE 79

CRITERION-REFERENCED MEASURE

Questions

1. What is the proper sequence for torquing wheel nuts with 4 lug nuts?
2. Why should the hub cap not be placed upside down on the concrete floor?
3. One of the most important things when torquing a series of nuts or bolts is
   a. torque all nuts or bolts to 5% under manufacturer's specifications.
   b. torque all nuts or bolts to 5% over manufacturer's specifications.
   c. torque all nuts and bolts evenly.
   d. none of the above.

Answers

1. top, bottom, left, right
2. the concrete will scratch the hub cap
3. c

Practical Application

Have the students torque wheel lug nuts.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 79 to determine if the assignment was completed for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 79

TORQUING WHEEL LUG NUTS

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Removed wheel covers (hub caps).		
3. Using suitable socket and torque wrench, tightened wheel nuts to manufacturer's specifications.		
4. Replaced hub caps (wheel covers).		
5. Returned vehicle to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

DUTY MAINTAINING BRAKE SYSTEM

PERFORMANCE OBJECTIVE 80

TASK

Check and service brake fluid levels.

STANDARD OF PERFORMANCE OF TASK

Master cylinder level should be full without overflowing.

SOURCE OF STANDARD

Writing Team of Incumbent Workers

CONDITIONS FOR PERFORMANCE OF TASK

Screwdriver
Adjustable wrench (6")
Brake fluid
Work order

ENABLING OBJECTIVES

1. Read and interpret a work order.
2. Identify and use simple hand tools.
3. Know safety precautions to be taken with brake fluid.

RESOURCE

Stockel and Stockel. **Auto Service and Repair,** pp. 677-85.

TEACHING ACTIVITIES

1. Explain purpose of the brake fluid in the brake system.
2. Discuss the importance of keeping the fluid clean and free of contamination.
3. Discuss why only recommended fluids should be used.
4. Explain the different types of reservoirs.
5. Discuss the hazards of spilling brake fluid on paint.
6. Have the students practice servicing different types of master cylinders.

PERFORMANCE OBJECTIVE 80

CRITERION-REFERENCED MEASURE

Questions

1. Why is it so important to keep brake fluid clean and free of contaminants?
2. If no manufacturer's specifications are available, to what level should the brake fluid reservoir be filled?
3. What should be done if brake fluid is accidentally spilled on the painted surface?

Answers

1. because of the small orifices and rubber seals in the system
2. about 1/4 inch from the top
3. wipe off and wash with soap and water

Practical Application

Have the students check and service brake fluid levels.

Method of Evaluating Practical Application

Use Checklist For Performance Objective 80 to determine if the assignment was complete for competency.

CHECKLIST FOR PERFORMANCE OBJECTIVE 80

CHECKING AND SERVICING BRAKE FLUID LEVELS

Student's Name **Date**

DIRECTIONS TO STUDENT — Prepare the proper equipment Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR — Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 100 percent is required for competency.

ITEMS TO BE EVALUATED	RATING	
	Satisfactory	Unsatisfactory
1. Obtained work order.		
2. Raised hood.		
3. Checked and brought brake fluid level to full.		
4. Returned vehicle to service.		

APPROVED: YES _____ NO _____

Evaluator's Signature **Date**

APPENDICES

APPENDIX A

DUTY/TASK LIST

Auto Mechanics Suspension Systems, Brakes and Steering
OE: 17.0302

Auto Mechanics Suspension System, Brakes and Steering
DOT: 620.261-010
DOT: 620.281-038-front end
DOT: 620.281-026-brakes

APPENDIX A

DUTY/TASK LIST

DUTY/TASK	PO/Page No.
A. MAINTAINING SUSPENSION	
Check air pressure and inflate tires.	1/5
Inspect tires and wheels	2/8
Inspect suspension system.	3/11
Remove and replace front wheel bearings (drum brakes)	4/14
R & R front wheel bearings (disc brakes)	5/18
Repack wheel bearings.	6/22
R & R shock absorbers.	7/25
R & R control arm.	8/28
R & R control arm bushings.	9/32
R & R ball joints.	10/35
R & R torsion bar.	11/39
R & R coil springs.	12/42
R & R king pins.	13/46
R & R spindle	14/50
R & R McPherson strut assembly.	15/54
Replace McPherson strut assembly cartridge.	16/57
R & R trunnion pin assembly	17/60
R & R leaf spring assembly	18/63
R & R spring hangers	19/66
R & R I-beam	20/69
R & R stabilizer and stabilizer bushings	21/73
B. MAINTAINING STEERING SYSTEM	
Inspect steering gear and linkage.	22/77
Check and service fluid level.	23/80
Lubricate steering gear and linkage.	24/83
Rotate tires.	25/86
Balance wheel and tire assembly.	26/99
Adjust steering sector.	27/93
R & R steering linkage components.	28/96
R & R manual steering sector	29/100
R & R steering damper.	30/103
R & R power steering hoses.	31/106
R & R steering system belts and set tension.	32/109
R & R power steering cylinder.	33/112
R & R power steering control valve assembly.	34/115
R & R power steering control valve assembly.	35/119
Rebuild power steering pump.	36/123
R & R rack and pinion power steering assembly.	37/126
R & R rack and pinion manual steering assembly.	38/130
Align front end	39/133
Adjust toe-in	40/136
Center steering wheel	41/139

DUTY/TASK	PO/Page No.
Align rear wheels	42/142
R & R steering wheel	43/145
R & R mast jacket assembly	44/148
R & R tilt wheel and telescopic	45/152
R & R steering column	46/155
Rebuild steering column	47/159
R & R steering column bearings, shift tube andsocket	48/162
R & R turn signal switch	49/165
R & R ignition switch rack	50/168
R & R emergency flasher switch	51/171
Replace shift detent in column.	52/174
R & R power steering seals (steering box)	53/177
C. MAINTAINING BRAKE SYSTEM	
Check brake operations	54/181
Inspect brake hose and lines	55/184
R & R brake hose	56/187
R & R brake line	57/190
Adjust brake shoes	58/193
Free-up parking cable and linkage	59/196
Adjust parking brake linkage	60/199
R & R parking brake cable and linkage	61/202
R & R brake shoes	62/205
R & R disk brake pads	63/209
R & R self adjusters	64/213
R & R wheel cylinders	65/217
Rebuild wheel cylinder	66/221
Grind (turn) brake drum	67/224
R & R disc brake rotor	68/227
R & R caliper assembly	69/230
Rebuild caliper assembly	70/233
R & R master cylinder	71/236
R & R hydro-brake booster unit	72/239
Bleed brake system	73/242
R & R proportioning valve (combinationvalve)	74/245
Test brake anti-lock system	75/248
Replace defective components in brake anti-lock system	76/251
Test rotor parallelism	77/254
Test rotor run-out	78/257
Torque wheel lug nuts	79/260
Check and service brake fluid levels	80/263

APPENDIX B

DEFINITION OF TERMS

APPENDIX B

DEFINITION OF TERMS

A number of terms frequently used in this guide may be unfamiliar to the reader; others may be familiar, but in the context of this handbook have been assigned special meanings.

AFFECTIVE.
Skills which emphasize an attitude, feeling, emotion, or degree of acceptance and rejection.

CATALOG.
A comprehensive collection of performance objectives, performance guides, and related data developed in a specific domain.

CBVE (COMPETENCY-BASED VOCATIONAL EDUCATION).
A methodology of instruction that (a) identifies the abilities and skills needed for on-the-job performance; (b) informs students and teachers of the precise and detailed learning objectives required to achieve these competencies; (c) emphasizes performance standards in testing, course requirements, and/or graduation; and (d) facilitates learning by letting each student master the tasks prior to advancing to another.

CHECKPOINT.
A point in the development of the V-TECS product when material must be sent to V-TECS central office for quality review.

CIP (CLASSIFICATION OF INSTRUCTION PROGRAM) CODE.
A code developed by the U.S. Office of Education to identify a specific cluster of related jobs for training program identification.

COGNITIVE.
Skills which emphasize the recall of knowledge and development of intellectual abilities.

COMPETENCY.
Proficiency in the knowledge and skills required of workers in a particular occupation or occupational specialty; a term used by educators to mean essentially program goal, duty, task, or objective. In some cases the terms are essentially synonymous.

CONDITIONS.
Describes the situation for competent task performance, including tools and equipment to be used, and limitations under which the tasks will be performed.

CONSORTIUM.
A group of state agencies, institutions, or other entities which have been legally constituted through letters of commitment, agreements, or by assignment of higher authorities to work together toward the solution of problems in education. A consortium, for the purposes of this work, must have membership from autonomous agencies and institutions which cut across state boundaries as they attempt to solve problems or meet goals.

CRITERION-REFERENCED MEASURES.
An evaluative procedure used to determine if a student has mastered a performance objective.

CROSS-REFERENCE TABLE.
A table that identifies the relationship among duties and tasks found in the occupational inventory and the performance objectives in the final catalog. Also noted are percentages of incumbents performing the tasks by D.O.T.

CURRICULUM GUIDE.
An instructional resource developed from a V-TECS catalog to guide CBVE for an occupation.

DICTIONARY OF OCCUPATIONAL TITLES (D.O.T.).
A document published by the U.S. Department of Labor, Employment and Training Administration. This publication groups occupations into systematic occupational classification structures based on interrelationships of job tasks and requirements.

DISTRACTOR.
An incorrect response to a multiple-choice or true/false test item.

DOMAIN (OCCUPATIONAL DOMAIN).
A group of job titles that are related on the basis of required skills and knowledge.

D.O.T. CODE.
A nine-digit number used to identify a specific job within a given calendar year.

DUTY.
A cluster of related tasks performed by incumbent workers in an occupational domain.

ENABLING OBJECTIVE.
An objective related to background knowledge or skills that are prerequisite to the mastery of a given task.

FIELD REVIEW.
The process of using and refining drafts of V-TECS materials for the purpose of identifying content errors or technical problems.

GUIDE SHEET.
Instructional information including the duty, performance objective, task, performance of standard, survey of standard, conditions for performance of tasks, enabling objectives, resources, teaching activities, criterion-reference measures, and performance guide.

JOB.
A group of tasks performed by a job incumbent.

JOB INCUMBENT.
An individual who is currently employed in an occupation.

OCCUPATIONAL ANALYSIS (Task Analysis).
The process of reviewing elements of a job for the purpose of improving training program content across program levels of vocational-technical education.

OCCUPATIONAL INVENTORY (Task Inventory Booklet).
A survey instrument listing tasks performed and tools and equipment used by job incumbents in an occupational domain.

OCCUPATIONAL SURVEY.
The procedures for collecting data to identify the duties and tasks that comprise one or more jobs, job types, or career field ladders for the collection and analysis of information concerning such duties.

O.E./CIP CODE.
A code developed by the U.S. Office of Education to identify a specific cluster of related jobs for training program identification.

PERFORMANCE-BASED INSTRUCTION.
Instruction which requires the learners demonstration of specific competencies. The desired abilities are selected before the instruction is described and are clearly defined as observable performance objectives.

PERFORMANCE CHECKLIST.
A list of performance steps derived from the performance guide to record acceptable or unacceptable performance of each step of a task.

PERFORMANCE GUIDE (PG).
A series of steps required for performance of a task arranged in the sequence ordinarily followed.

PERFORMANCE OBJECTIVE (PO).
A statement, in precise measurable terms, of a particular behavior to be exhibited by a learner under specified conditions, including a standard of performance.

PSYCHOMOTOR.
Skills which emphasize manipulation of material or tools.

QUALITY REVIEW.
A review of content by V-TECS staff or designated representative to examine quality of content, format, and style of V-TECS product(s).

RESOURCES.
Materials which are used to develop instruction and/or learner-specific objectives.

SOURCE OF STANDARD.
A person or origin from which the information establishing the standard is received.

STANDARD.
The criteria used to determine if a task has been successfully or unsuccessfully performed.

STATE-OF-THE-ART REFERENCE.
Current materials from which information or resources can be found to facilitate instruction.

STATE-OF-THE-ART (SOA) STUDY.
Research conducted to determine the current status of performance-based instructional materials and practices in the domain area under study and to obtain other information that might be useful in catalog development.

SUBJECT-MATTER EXPERT.
A highly experienced person (incumbent worker/instructor) who assists in identifying task performance steps, skills, and knowledge necessary to perform the job.

TASK.
A unit of work activity which constitutes logical and necessary steps in the performance of a duty. A task has a definite beginning and ending point in its accomplishments and generally consists of two or more definite steps.

TASK ANALYSIS.
The process of reviewing elements of a job for the purpose of improving training program content across program levels of vocational technical education.

TASK LIST.
A list of tasks performed by incumbents in a specific occupation domain.

TEACHING ACTIVITIES.
Methods and/or procedures for delivering instructional content to students.

TEST-ITEM BANK.
A collection of criterion-referenced test items coded for input and retrieval by computer or manual methods.

VALIDATION.
The process of assuring that all aspects of an occupational task analysis identifies the skills, knowledge, and attitudes performed in the occupation.

VERIFICATION.
The procedure of collecting data to substantiate an existing product; for example, task list verification.

V-TECS.
An acronym representing: Vocational-Technical Education Consortium of States; 795 Peachtree Street, N.E., Atlanta, Georgia 30365. A consortium of states that provide competency-based, vocational-technical education materials while conserving time and money through shared development and dissemination.

V-TECS CATALOG.
An incumbent-based description of the duties, tasks, performance objectives, performance guides, and related data in a specified occupation.

WORKING CONDITIONS.
The atmospheric and environmental conditions under which a worker performs a specific job.

WRITING TEAM.
A team of people representing instructors with subject matter expertise; persons having knowledge and experience in developing criterion-referenced measures; local or state supervisors in the domain being developed; workers and supervisors of incumbent workers whose function is to analyze occupational data and develop performance objectives for specific D.O.T. areas.

APPENDIX C

TOOLS/EQUIPMENT/WORK AIDS

APPENDIX C

TOOLS/EQUIPMENT/WORK AIDS BY

PERCENTAGE OF INCUMBENTS USING

Tools/Equipment/Work Aids	Percent Using
Adjustable wrench 3"	19.1
Adjustable wrench 4"	34.4
Adjustable wrench 6"	36.5
Adjustable wrench 8"	20.4
Adjustable wrench 10"	32.6
Adjustable wrench 12"	85.0
Adjustable wrench 15"	20.0
Adjustable wrench 18"	10.0
Air compressor	100.0
Air chisels	80.0
Arbor press	20.2
Axle stands	32.7
Allen wrenches 2mm-7mm	98.4
Allen wrenches .050"--3/8"	96.5
Box end wrench set 3/8"-1/8"	95.4
Box end wrench set 8mm-18mm	97.4
Bearing packer, hand operated	20.6
Brake spring tool	82.1
Brake bleeder pressure	60.1
"Brake shop," mobile with disc attachments	40.2
Chassis lubricating system	100.0
Continuity test light	100.0
Digital electronic volt meter	20.0
Disk brake caliper hone	100.0
Drag link and shock tool	81.6
Drill-3/8" variable speed, reversible	99.8
Drill bits 1/16"-3/8"	98.3
Dial indicator set	80.4
Brake cylinder hone, surfacing	97.4
Brake cylinder hone	99.6
Brake clamps	61.4
Brake shoe setting gauge	80.2
Brake spring pliers	99.0
Brake rotor gauge	86.0
Easy-out set	78.0
Feeler gauge	100.0
Files and handles, 4",6",10" and 12" fine	60.0
Files and handles, 6", 10", and 12" course	55.8
Files and handles, 6' and 12' half round	80.1
Flare nut wrench set 3/8"-11/16"	80.2
Flare nut wrench set 7mm-17mm	60.4

Tools/Equipment/Work Aids	Percent Using
Floor jack	100.0
Gauge rotor runout	80.0
Gauge rotor thickness	62.0
Gauge, brake drum	80.4
Gauge, runout	52.2
Hoist, swing arm	56.9
Hoist, contact	19.4
Hoist frame	19.4
Hydraulic press	58.7
Hammer, ball peen, 24 oz.	83.6
Hammer, brass, hand sledge 5 lb.	35.8
Hammer, medium ball peen	100.0
Hammer, soft face	34.6
Brake spoon	100.0
Blow gun, rubber tip (OSHA approved)	81.0
Chisel, 5/8" cold	74.4
Chisel, 3/8" cold	100.0
Chisel, 3/4" cold	62.3
Chisel, 5/16" cold	100.0
Combination wrenches	100.0
Creeper	82.4
Hacksaw	99.0
Impact ratchet set 3/8" drive with sockets and metric	42.4
Impact wrench	98.4
Lube equipment	98.4
Magnetic pickup tool	95.8
Mechanics steel ruler	80.0
Micrometers	57.6
Oil can, pump	100.0
Oxy-acetylene equipment	99.8
Parts cleaning tank	94.6
Pitman army pry bar	97.8
Pitman puller	97.8
Pliers, snap ring	100.0
Pliers, needle nose	100.0
Pliers, all purpose	100.0
Pliers, side cutting	100.0
Pliers, vise grip	94.6
Pliers, slip joint	95.7
Puller, two prong	100.0
Puller, drum	19.4
Puller, 3 jaw	92.8
Puller, straight line	56.4
Puller, steering wheel	82.6
Puller, universal slide hammer	83.4

Tools/Equipment/Work Aids	Percent Using
Puller, ball joint and U-joint removing - installing set	8.0
Screw drivers, clutch head 3/16", 5/16", 1/4", 3/8"	100.0
Screw drivers set common	100.0
Screw drivers set phillips	100.0
Screw pitch gauge, N.F., N.C. metric	3.0
Screw starter (standard and phillips)	4.4
Soldering gun	98.7
Socket set, 5/16", 3/4", 3/8" drive (6 pt)	95.4
Socket set, 3/8", 3/4" deep (6 pt)	99.6
Socket set, 6mm-19mm	92.7
Socket set, 9mm-19mm deep	78.4
Socket set, universal joint	79.5
Socket set, ratchet handles	94.6
Socket set, short, medium and long extension	96.8
Socket set, speed handle	81.4
Socket set, breaker bar	98.9
Tape measure	82.3
Tire mounting machine	100.0
Tire pressure gauge	100.0
Tap and die set, standard	80.0
Tap and die set, metric	1.8
Top tool chest, 6 drawer minimum	95.0
Tube cutter with flaring tool, double flare type	82.3
Tool box for merging	40.0
Torque wrench, 3/8" drive 5-75 ft. lbs.	21.0
Torque wrench, 1/2' drive 0-150 ft. lbs.	99.6
Universal brake adjusting tool	42.3
Wheel balancer, on car, spin type	12.7
Wheel balancer, off car, electronic type	86.7
Wheel alignment equipment, rack type	98.4
Wheel alignment equipment pit type	19.1
Wheel alignment gauge, 4 wheel	18.6

APPENDIX D

SOURCE OF STANDARD

APPENDIX D

SOURCE OF STANDARD

Writing Team of Incumbent Workers.

APPENDIX E

STATE-OF-THE-ART-LITERATURE

APPENDIX E

STATE-OF-THE-ART LITERATURE

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APPENDIX F

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BIBLIOGRAPHY COMPILED BY THE SOUTH CAROLINA WRITING TEAM

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